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WEATHER OF THE MONTH

CHARTS

CORRECTION

MONTHLY WEATHER REVIEW, May, 1926:

Page 194, first column, bottom line, "Eó" should be "$\bar{E}_0$."

† In marine separate.

MONTHLY WEATHER REVIEW

Editor, ALFRED J. HENRY **Assistant Editor, BURTON M. VARNEY**

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LIGHTNING AND FOREST FIRES IN THE NORTHERN ROCKY MOUNTAIN REGION

By H. T. GISBORNE, Associate Silviculturist

[Northern Rocky Mountain Forest Experiment Station May 14, 1926]

During the past 18 years lightning has caused 39 per cent of the forest fires in the northern Rocky Mountain district, which includes Montana, northern Idaho, and a small portion of northeastern Washington. For the seasons of 1924 and 1925 the figures are 51 per cent and 80 per cent, respectively. As long as such conditions prevail it should be of decided value to know everything possible about the occurrence, behavior, and characteristics of lightning storms in time and place.

In this summary are presented the facts so far brought to light by a compilation of the lightning storm reports prepared largely by the Forest Service fire lookouts, based upon the conditions of 1924 and 1925.

FIG. I

BASIC INFORMATION

A special form, standard for all national forests west of the Mississippi River, is used in reporting the characteristics of each lightning storm seen by Forest Service fire lookouts.

During the four seasons 1922 to 1925, inclusive, reports have been received from approximately 170 stations in this district. The locations of 166 of these lookouts are shown in Figure 1. The number and distribution of these observation points, together with their location largely on the higher mountain tops with an extensive horizon and with a man on duty constantly, insure the reporting of nearly every electrical storm occurring in the northern Rocky Mountain region, at least during the period July 1 to September 1, when nearly all the lookouts are manned.

OCCURRENCE OF LIGHTNING STORMS

As a result of the excellence of these locations it is to be expected that the reports obtained indicate a more frequent occurrence of lightning storms than do the records of the United States Weather Bureau obtained at fewer stations, all located at lower elevations and with much more limited horizons. The Atlas of American Agriculture, Part II, Climate, prepared by the United States Weather Bureau, shows for northern Idaho and western Montana an average of from 15 to 30 thunderstorm days per year. based on their records of 1904 to 1913. The lookout records show that between June 1 and September 30 one or more stations reported the occurrence of lightning storms on 85 days in 1924 and on 95 days in 1925, or more than three times the number of days indicated by the Weather Bureau.

Some of this difference between the Forest Service and the Weather Bureau reports may be due to a greater prevalence of lightning storms in recent years as compared to the period 1904 to 1913. It is the rather popular belief that such an increase has taken place. The Forest Service lookout records do not as yet cover a period of years long enough to warrant dependable conclusions on this phase of the problem. It is believed, however, that the Weather Bureau records are correct for the horizon covered by their stations, and that the greater part of the difference between the two sets of records is due to the almost complete observation of the entire horizon in this region by the Forest Service lookouts.

Some variations in the occurrence of thunderstorms are shown for the past four summers by Figure 2. In considering this chart, one should remember that it shows the number of stations reporting electrical storms each day, and not the exact number of storms. Very often from two to six or more stations observe and report the same storm. The chart shows, nevertheless, that thunderstorms occur in waves which vary considerably from year to year. During 1922, 1923, and 1924, the number of storms was rather evenly distributed throughout July and August. During 1925, however, it was concentrated very largely in July and seems to exhibit the presence of some major control, slowly building up, reaching a peak of activity, and then dying off rather rapidly.

Probably the greatest value of such charts will be to meteorologists, who will be able, by comparing the peaks of storm occurrence with the weather maps, to determine what combinations of atmospheric conditions caused these peaks. With this knowledge the official forecasters

may be able to predict storm periods more dependably and perhaps at longer range.

Our records show that July and August are decidedly he thunderstorm months in this region. Of the total number of reports received in 1924 and 1925, 7 per cent showed storms in June, 51 per cent in July, 30 per cent in August, and 12 per cent in September. As the full number of lookout stations are not manned and reporting throughout June and September, however, it is probable that these two months experience more storms than are indicated.

It is well known that the subdivisions of the northern Rocky Mountains undergo very different degrees of fire danger, and the present compilation shows marked variations in the behavior of the lighning factor in this problem. In combining the records of individual National Forests to determine regional characteristics of lightning storms, a grouping of the Forests according to some of the more important fire-weather factors involved (this grouping was devised by Mr. Flint, inspector in charge of fire control in this district) has here been followed. Certain important regional differences are shown in Table 1 and Figure 3.

TABLE 1.—*Occurrence of lightning storms*

Group	National forests	Per cent of total area studied	Per cent of total number of reports received	Number of storm days				
				1924		1925		Total
				July	August	July	August	
I	Beaverhead, Helena, Jefferson, Lewis & Clark	20	12	24	17	23	23	87
II	Bitterroot, Missoula	12	9	13	11	24	15	54
III	Blackfeet, Flathead, Cabinet, Kootenai, Lolo, Pend Oreille	37	35	22	13	22	21	78
IV	Clearwater, Coeur d'Alene, Kaniksu, St. Joe	15	19	10	11	20	16	57
V	Nezperce, Selway	16	25	14	12	22	17	65
All forests named		100	100	28	21	29	28	106

From this grouping of forests, it is evident that the greatest number of thunderstorm days occur in eastern Montana (Group I), even though the ratio of number of reporting stations to area involved is there the least. It does not follow from this, however, that the fire danger from lightning is greatest in eastern Montana. In fact, almost the reverse seems to be true. Groups IV and V which experience a noticeably smaller number of thunderstorm days, suffer by far the greater proportion of lightning fires. The explanation of this condition probably lies in the fact that thunderstorm days are usually rainy; therefore the more thunderstorms the more rain, and the fewer the fires because the rains maintain a higher moisture content in the fuels. The variable character of timber growth also may have an important effect.

CHARACTERISTICS OF LIGHTNING STORMS

The records of 1924 and 1925 show that in the lightning storms in this district it usually rains, on the average, for about 11 minutes before the lightning begins to strike, and about 34 minutes after the lightning has ceased. There is a slight difference in this respect between those storms which start fires and those which do not. About 700 observations of fire-starting storms show an average of 9 rain minutes ahead of the lightning, and rain for 30 minutes following it; a total of 39 minutes, exclusive of the duration of the lightning overhead. The average of about 1,100 reports of nonfire-starting storms show 12 minutes of rain before, and 38 minutes following; or a total of 50 minutes rain, excluding the duration of the lightning. This difference of only 11 minutes may or may not be significant, but it is worth noting that those storms with a total of more than 40 minutes of rain before and after the lightning probably are less dangerous than those with appreciably less rain. It is easy for the lookouts to time the duration of rainfall, to estimate its intensity, and to report these facts to the district rangers so that more dependable opinions may be formed as to the probable danger which will result from each storm, and hence the action necessary.

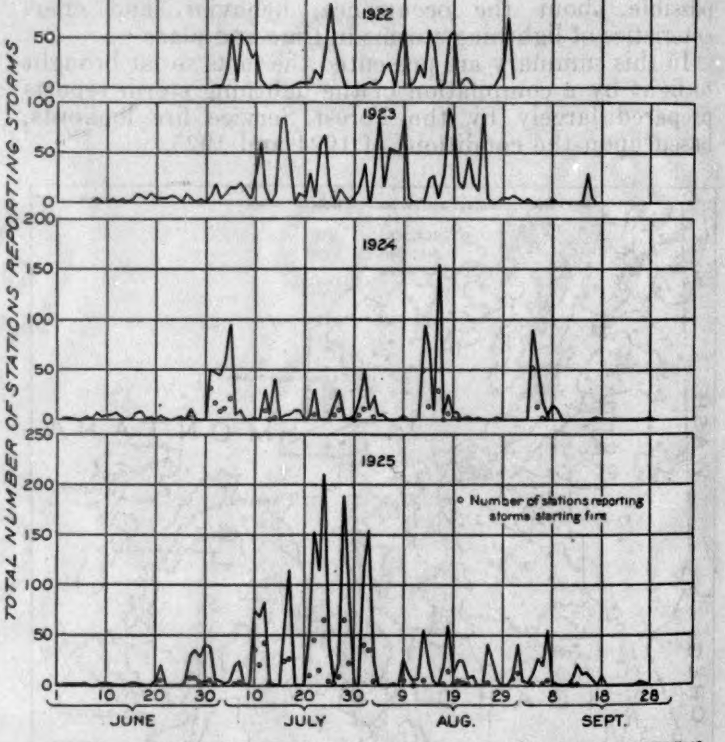

FIG. 2. - NUMBER OF LOOKOUT STATIONS REPORTING LIGHTNING STORMS

These records of duration of rainfall before and after the lightning also exhibit regional differences of appreciable amount, and are as follows:

Group	Number of minutes rainfall		Group	Number of minutes rainfall	
	Safe storms	Dangerous storms		Safe storms	Dangerous storms
I	42	23	IV	60	44
II	37	20	V	57	41
III	53	37	District	50	39

The conclusion indicated by the above tabulation, that there is less fire danger with longer rain, is substantiated by the reports for 1924 which show a total of 53 minutes rain before and after the average storm, whereas in 1925 the average was only 41 minutes. There were 691

lightning fires in 1924 and 1,242 in 1925. Not all of this difference can be ascribed to the 12-minute difference in average rainfall, but this probably was a contributing factor.

A further factor, undoubtedly contributing to the greater number of lightning fires in 1925, was the percentage of lightning bolts striking the earth. The average for both 1924 and 1925 is 33 per cent, based on 3,232 reports. For 1924, however, only 30 per cent of the lightning was reported as striking, for 1925 the average was 34 per cent—another small but possibly significant difference which helped to cause more fires during 1925.

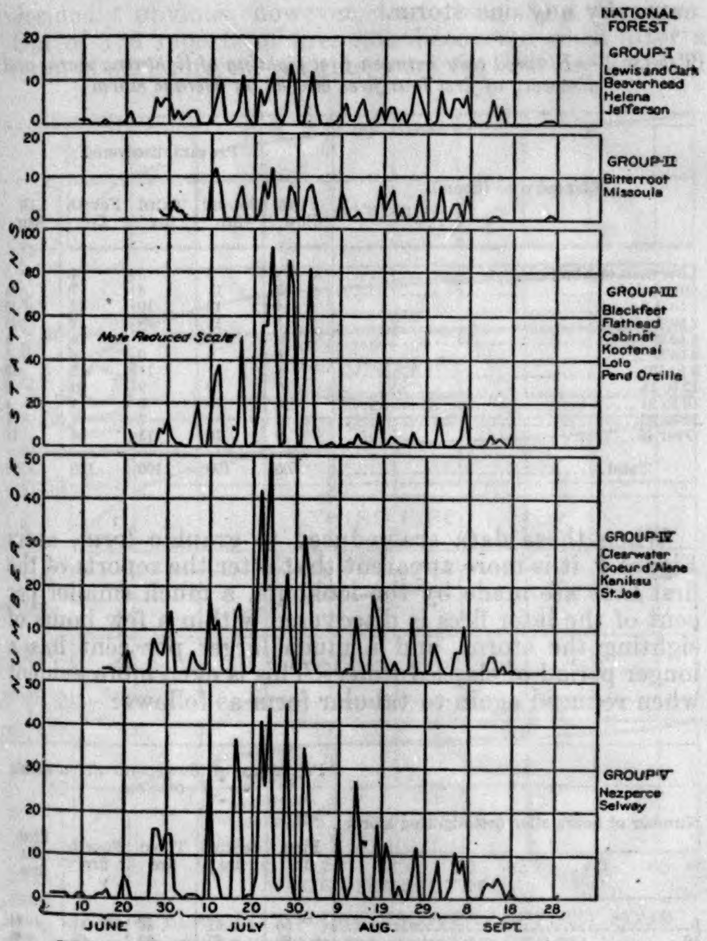

FIG. 3.—NUMBER OF STATIONS REPORTING LIGHTNING STORMS – 1926

The shorter rainfall, the greater percentage of lightning striking, the difference of 10 more thunderstorm days in 1925, and the concentration of the storms into one month instead of two, seem to have been the major factors resulting in nearly twice as many lightning fires in 1925 as compared to 1924.

Just as there was a difference between regions in the number of storm days and in the duration of rainfall, so also there appears to be a significant difference in the percentage of lightning striking the ground, the most lightning striking in northern Idaho where the most lightning fires commonly occur. These differences are as follows:

Group	Percentage of lightning striking the earth		Group	Percentage of lightning striking the earth	
	Safe storms	Dangerous storms		Safe storms	Dangerous storms
I	28	49	IV	26	48
II	27	41	V	36	42
III	31	39	District	30	43

This table is based only on those 2,186 reports which stated definitely whether or not the storm obsreved was a fire starter. One thousand and forty-six additional reports gave the percentage of lightning confined to the clouds, but failed to classify the storm as "safe" or "dangerous," in so far as it failed to start, or did start, forest fires.

For the national forest district as a whole, the records indicate that during 1924 and 1925 about 25 per cent of the storms were first seen in the morning. For 1924 the figure was 22.6 per cent, and for 1925 it was 23.6 per cent, showing no significant difference. There also appears to be no difference between the four months, June to September. By groups, however, there does appear to be a noticeable difference in the percentage of storms first sighted in the morning, as shown by Table 2.

TABLE 2.—*Morning discovery of lightning storms*

Group	Total number of reports	Number of morning reports	Number storms first seen in morning	Group	Total number of reports	Number of morning reports	Number storms first seen in morning
I	469	95	20	IV	712	173	24
II	336	44	13	V	954	265	28
III	1,328	307	23	District	3,799	884	23

Apparently Group II has the smallest percentage of storms appearing in the morning, whereas Group V has the highest. There is no definite evidence to indicate whether or not the first appearance of storms in the morning, rather than in the afternoon, provides a better warning of approaching danger, but as the most common hours of occurrence of thunderstorms are from 2. p. m. to 6 p. m., it would seem that Group V should be better forewarned than Group II, if the fire lookouts report to the forest rangers as soon as storms are sighted.

The reports for 1924 and 1925 also show that only 4 per cent of the storms last through midnight. [AUTHOR'S NOTE.—The lightning storm of July 12–13, 1926, which started over 200 forest fires on the Kaniksu Forest alone, began about 10 p. m. and continued until about 3 a. m.]

It has been suggested that rain gauges should be installed at all lookout stations and the amount of the rain with thunderstorms measured instead of timing the duration of the rain. The reports show, however, that only 47 per cent of the lightning storms pass directly over the lookout stations, consequently if the rain gauge system were used it would provide measurements on only half the storms. Nevertheless, a few selected lookouts are being equipped with rain gauges, and as these stations report the amount of rain with each storm additional information of value will be obtained.

The ratio of safe to dangerous storms shows appreciable variation. For the district as a whole, it appears that during 1924 and 1925 about 6 storms out of 10 were safe, and 4 dangerous. The principal variation occurs between the subdivisions of the district, as follows:

Group	Percentage of safe storms		Percentage of fire-starting storms		Group	Percentage of safe storms		Percentage of fire-starting storms	
	1924	1925	1924	1925		1924	1925	1924	1925
I	87	94	13	6	IV	42	35	58	65
II	79	74	21	26	V	41	48	59	52
III	63	58	37	42	District	59	59	41	41

Thus, although the eastern Montana region experiences the most thunderstorm days, only 1 storm out of 10 is a fire-starter. In Groups IV and V, comprising all of the national forests in northern Idaho, except the Pend Oreille, well over half the storms, which were definitely classified, were dangerous.

In Figure 2 the charts for 1924 and 1925 show the number of reports of fire-starting storms and the total number of reports each day, so that the ratio is evident. Usually, with from two to five successive thunderstorm days in a wave, the first day or two brings the greatest percentage of reports indicating that fires resulted. This condition is most obvious in only one of the peaks of thunderstorm occurrence in 1925; it is very clear in three of the peaks of 1924, and it was shown by several cases in 1922 and 1923. The explanation probably lies in the fact that lightning, in the first day of a peak, strikes generally drier fuels than on the third or fourth day when rain has raised the fuel moisture contents high enough to reduce the ease of ignition appreciably. Consequently, warnings from the lookouts that thunderstorms are approaching should be given most attention immediately following any period that has been free from storms.

The compilation of the common direction of movement of storms on the different national forests brings out nothing not generally known before. The reports show the following percentage of storms moving in each of eight directions:

Storm moving toward the—	Group					
	I	II	III	IV	V	District
	Per cent of storms					
North	10	14	15	16	16	14
Northeast	33	33	31	37	47	36
East	39	40	28	26	26	30
Southeast	6	5	13	5	4	8
South	3	1	4	4	1	3
Southwest	3	1	3	5	1	3
West	2	3	3	2	0	2
Northwest	4	3	3	5	3	3
Stationary	0	0	0	0	2	1

There are rather slight differences between these subdivisions and it appears that approximately 88 per cent of the storms move north, northeast, east, or southeast. The most common directions of movement for each of the national forests are shown by the arrows in Figure 1, the lengths of the arrows being proportional to the percentage represented. Arrows are shown only for those directions in which 10 per cent or more of the storms moved.

LIGHTNING FIRES

One of the most interesting and practical phases of this study is the determination of the number of hours between first sighting each lightning storm and the time of discovering each fire caused by it. The summary for 1922 and 1923 indicated that in this period of elapsed time there lies a very appreciable warning which should be of use in preparing to fight lightning fires. The reports for 1924 and 1925 strongly substantiate this conclusion.

In the following summary, attention is paid only to the first four fires because there were only a few reports which gave the elapsed time on more than four fires cause by any one storm.

TABLE 3.—*Elapsed time between first sighting of lightning storm and discovery of first four fires caused by average storm*

Elapsed time (hours)	Per cent discovered				
	First fire	Second fire	Third fire	Fourth fire	All four
Less than one-half	9	5	5	4	7
One-half to 1	13	11	8	7	11
1 to 2	14	12	10	12	13
2 to 4	15	17	18	12	16
4 to 6	8	8	7	9	8
6 to 8	6	9	9	8	7
8 to 12	8	11	11	15	10
12 to 18	10	9	9	10	9
18 to 24	4	4	3	5	4
24 to 36	4	4	7	4	4
Over 48	9	10	13	14	11
Total	100	100	100	100	100

When these data are reduced to graphic form, as in Figure 4, it is more apparent that after the reports of the first fires are made by the lookouts, a much smaller per cent of the later fires is discovered within a few hours of sighting the storm, and a much larger per cent has a longer period of elapsed time. This is even more evident when reduced again to tabular form as follows:

Number of hours after first sighting storm	Percentage of fire reports which should be received				
	First fire	Second fire	Third fire	Fourth fire	First four fires
5	56	51	46	41	51
10	69	67	62	60	67
15	79	78	73	72	77
20	85	83	78	78	83
25	87	86	80	82	86
30	89	88	83	84	87
35	90	89	85	85	88
48 or more	100	100	100	100	100

This tabulation shows that there was a 5-hour warning for 49 per cent of the first four fires, a 10-hour warning for 33 per cent, 15 hours for 23 per cent, 20 hours for 17 per cent, 25 hours for 14 per cent, 30 hours for 13 per cent, and 35 hours for 12 per cent. It is therefore apparent that the lookouts should report the first appearance of a lightning storm to their district headquarters where the information should be recognized as a warning of impending danger. As has been shown, for the entire region only 4 storms out of 10 are usually fire-starters, but for northern Idaho practically half the storms are dangerous. In either case it may be better to be unnecessarily prepared occasionally, rather than unprepared for the impending danger. Even without recourse to the thunderstorm forecasts by the United

States Weather Bureau, it is evident that fair warnings of lightning storm danger are already in the forester's hands if he knew how to use them.

There is one rather startling fact made apparent by the 1924 and 1925 reports of lightning fires. It is that 64 per cent of the lightning fires not discovered until more than 48 hours after the storm was first seen, are either the first or second fires in the order of discovery. One might think that nearly all the 48-hour fires would be fourth, fifth, sixth, or later in the order of discovery; that the first fire would be found within a few hours, the second a little later, etc., until after several fires had been discovered and 48 hours had elapsed, then would come the bulk of these so-called 48-hour fires. It is decidedly obvious, however, that this is not the case. Out of 155 reports of fires not discovered until after a lapse of 48 hours, 43 per cent were the first fire ascribed

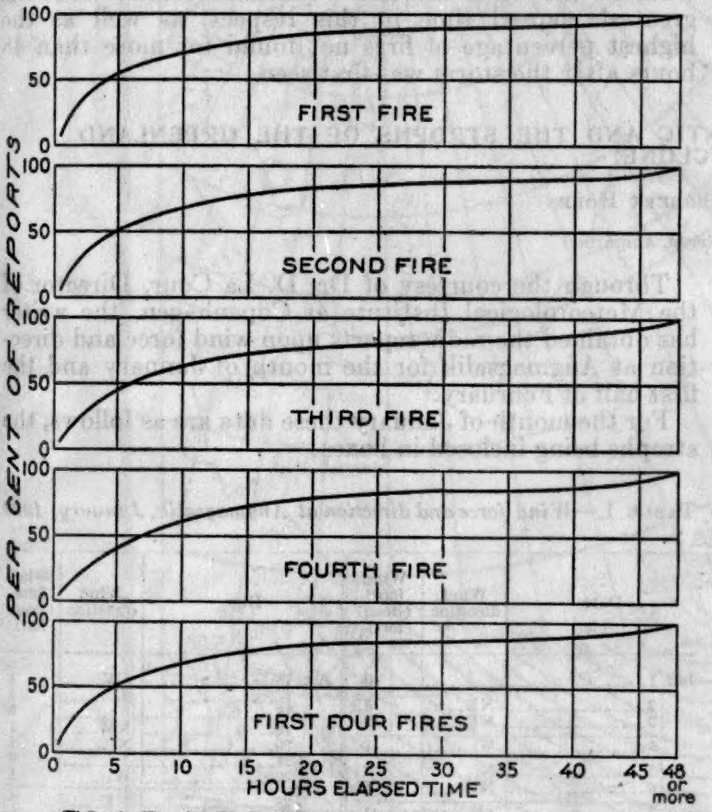

FIG 4. ELAPSED TIME IN DISCOVERY OF FIRST FOUR FIRES CAUSED BY AVERAGE STORM

to the storm, 21 per cent the second fire, 16 per cent the third fire, 10 per cent the fourth, and only 10 per cent were fifth or later.

The explanation of this peculiar condition may lie in the fact that very frequently the lightning strikes wet fuels, few fires are set, and those few do not show up for over 48 hours. Hence it would seem that vigilant detection should not be at all relaxed by the lookouts after a storm has passed merely because no fires are found within the following 48 hours. About 9 per cent of all the lightning fires of 1924 and 1925 appear to have been 48-hour fires. Whether or not this appreciable percentage can be reduced by increased vigilance on the part of the lookouts remains to be determined.

The usable reports so far obtained are not yet sufficient in number to warrant a dependable comparison of one National Forest against another in respect to the speed of detection of lightning fires following the first sighting of the storm. If better records are obtained during the next two or three seasons, such a comparison should produce usable information.

By groups there are certain differences in the speed of detection brought out by the 1924 and 1925 records. These differences for the first fire are as follows:

Number of hours after first sighting storm	Group I	II	III	IV	V	District
	Percentage of first fire detections made					
5	54	70	50	64	58	56
10	70	80	62	75	74	69
15	77	83	72	83	83	79
20	80	87	80	87	88	85
25	80	90	84	90	92	87
30	81	92	84	92	93	89
35	86	93	85	93	94	90
48 or more	100	100	100	100	100	100

It is evident from this tabulation that Groups I and III, or the Montana forests excepting the Bitterroot-Missoula, are rather below the district average in the percentage of first fires discovered in less than 48 hours. The Bitterroot and Missoula National Forests as a group show the highest percentage of any group for first fires found within 10 hours after first sighting the storm.

These differences are undoubtedly due to several factors, and certainly should not be charged purely to the efficiency of the lookout personnel and locations. It would seem probable that the low percentage of first fires found within 10 hours in eastern Montana may be due partly to the greater wetness of the fuels which thereby burn more slowly, as well as to the relative lack of high elevation lookouts in that region. Furthermore, some of the minor differences undoubtedly are due to insufficient records, this entire comparison of regions being based on only 722 reports of first fires.

SUMMARY

Between June 1 and September 30 thunderstorms may be expected to occur in the northern Rocky Mountain region from 85 to 95 days out of the 122. There were 10 more thunderstorm days in 1925 than in 1924.

Peaks of thunderstorm occurrence, when over 50 stations report storms in one day, may be expected from 8 to 15 days, generally confined to July and August. The recording of these peaks should be of value in a study of the conditions which produced them, and so furnish a basis for better Weather Bureau forecasts.

The eastern Montana forests appear to experience the most thunderstorm days, but the least danger of lightning fires. It is believed that this is in part because nearly all thunderstorms bring rain and because the more rainy days the wetter the fuels and therefore the smaller number of fires.

For the past two years the records indicate that with the average lightning storm there is usually about 11 minutes of rain before the lightning begins to strike, and about 34 minutes rain after the lightning has ceased. Fire-starting storms showed an average of 9 minutes rain before, and 30 minutes following the lightning. Nonfire-starting lightning storms showed an average of 12 minutes rain before and 38 minutes following. The storms of 1925 brought an average of 12 minutes less rain than those of 1924.

A higher percentage of lightning bolts was also reported as striking the ground in 1925 as compared to 1924, the figures being 34 per cent and 30 per cent, respectively.

For the region as a whole, about 23 per cent of the lightning storms are first seen in the morning, the Selway-Nezperce group showing the highest per cent, and the Bitterroot-Missoula the lowest. Only 4 per cent of the storms last through midnight, and only 47 per cent pass directly over the lookouts.

About 6 storms out of 10 appear to be safe, and about 4 out of 10, fire-starters. Subdivisions of the district showed marked differences in this respect, the eastern Montana forests having a ratio of about 9 safe to 1 dangerous storm, and the Idaho forests a ratio of 1 to 1.

Usually the first day or two of a wave of lightning storms brings the greatest percentage of fires, the following storm days being less dangerous.

About 88 per cent of the lightning storms in this region travel toward the north, northeast, east, or southeast. Sixty-six per cent go northeast or east.

The time elapsing between first sighting a lightning storm and the discovery of the fires caused by it offers a very material warning period in which to prepare for the impending danger. About 56 per cent of the first discoveries will be made within five hours after first sighting the storm, that period being available to prepare for 44 per cent of the first discoveries, 49 per cent of the second, 54 per cent of the third, and 59 per cent of the fourth discoveries. Nine per cent of the first discoveries are not made till more than 48 hours after the storm is first seen, and of all those not discovered till after 48 hours 43 per cent are first discoveries, not preceded by any other fires. Among the subdivisions of the district there are marked differences in the speed of discovery of the first fire, and in the percentage of fires not discovered till after 48 hours. The Bitterroot-Missoula group shows the quickest discovery of the first fires, whereas the other western Montana forests show the greatest elapsed time in this respect, as well as the highest percentage of fires not found for more than 48 hours after the storm was first seen.

THE JANUARY STORMS OVER THE NORTH ALANTIC AND THE STROPHS OF THE GREENLAND ANTICYCLONE

By William Herbert Hobbs

[University of Michigan, Ann Arbor]

The exceptional severity of the storms in January, 1925, over the North Atlantic has been brought home to us through the loss of a number of vessels, including the *Antinoe* after her crew had been rescued by the *President Roosevelt*. Sir Napier Shaw in an article published in the London Times of February 6 drew attention to the close parallel between the atmospheric conditions over the Atlantic last January and during the famous storms of the winter of 1898 and 1899 (*1*).

In each case there developed a vast depression within the atmosphere in the area south of Greenland—an area with a diameter of about 2,000 miles from which there had been removed, according to computations, about two million million tons of air.

The present writer was so struck by the peculiar twin depressions which followed each other during the closing week of last January that the possibility occurred to him of establishing a connection in time between the storm depressions over the Atlantic and the outrushes of cold air from the inland ice of Greenland (*2*).

Study of the recorded observations (*3*) upon wind force and direction at the Greenland weather stations had already indicated that the wind from the inland ice seldom reached hurricane velocity at these stations due to overriding in the lee of the steep marginal slope of the glacier (*4*). To this general rule there appeared, however, to be partial exceptions in the cases of the Danish stations of Angmagsalik on the southeast coast and of Nanortalik on the south coast. These stations are farther removed than the others from the margin of the glacier, and for this reason they feel the strophs of the anticyclone during the winter season, though hardly with their full intensity. At Angmagsalik, where the station is distant 60 miles from the ice margin, the winds blowing down off the glacier arrive from the northerly or northeasterly quarter. In this vicinity the inland ice pushes far out to the eastward and northeastward of the station on its northern side, and the slope winds which start radially outward from the interior are deviated to the right by earth rotation and as a consequence reach the station coming as a rule from the north or northeast.

Through the courtesy of Dr. D. La Cour, Director of the Meteorological Institute at Copenhagen, the writer has obtained the radio reports upon wind force and direction at Angmagsalik for the month of January and the first half of February.[1]

For the month of January these data are as follows, the strophs being inclosed in boxes:

TABLE 1.—*Wind force and direction at Angmagsalik, January, 1926*

Date	Wind direction	Wind force (Beaufort)	Date	Wind direction	Wind force (Beaufort)
Jan. 1		0	Jan. 16	SW	1
2	NE	3	17	S	1
3	NE	9	18		0
4	W	1	19	NW	1
5	N	3	20	N	1
6	N	6	21		0
7	SE	1	22	W	1
8	W	1	23	NE	5
9	S	6	24	NE	9
10	SW	1	25	E	1
11	SW	2	26	N	5
12	E	2	27	NE	9
13	S	2	28		0
14	W	1	29	N	2
15	SE	2	30	S	3
			31	E	1

From these data it appears that there were during the month of January four strophs from the glacial anticyclone, and these are grouped in a twin relation with a 24-hour interval which is valuable for purposes of identification. Dr. George C. Simpson, head of the British Meteorological Office, has kindly furnished the writer with copies of the synoptic weather charts for the northeastern Atlantic and western Europe for the month of January, and from these it appears that marked atmospheric minima were centered in the general region lying south of Greenland upon the following dates:

[1] These, it appears, are regularly issued in the Icelandic weather bulletins sent out by "Vedurstofan," Reykjavik.

TABLE 2.—*Pronounced atmospheric minima south of Greenland, January, 1926*

Day and hour	Air pressure in millibars at center	Approximate position of center: Latitude	Approximate position of center: Longitude
		°	°
Jan. 5^{18}	968	60 N.	30 W.
6^{7}	972	60 N.	30 W.
9^{18}	968	55 N.	40 W.
10^{7}	956	55 N.	30 W.
24^{18}	968	55 N.	30 W.
26^{7}	968	55 N.	30 W.
28^{7}	964	55 N.	30 W.
Feb. 1^{7}	952	55 N.	25 W.

TABLE 3.—*Wind force and direction at Angmagsalik, February 1-15, 1926*

Day	Wind direction	Wind force (Beaufort)	Day	Wind direction	Wind force (Beaufort)
Feb. 1	SW	2	Feb. 8	N	2
2	SE	4	9	NE	1
3		0	10	S	1
4	E	3	11		0
5	NE	5	12	SW	1
6	SW	1	13	NE	5
7		0	14	E	10
			15	NE	5

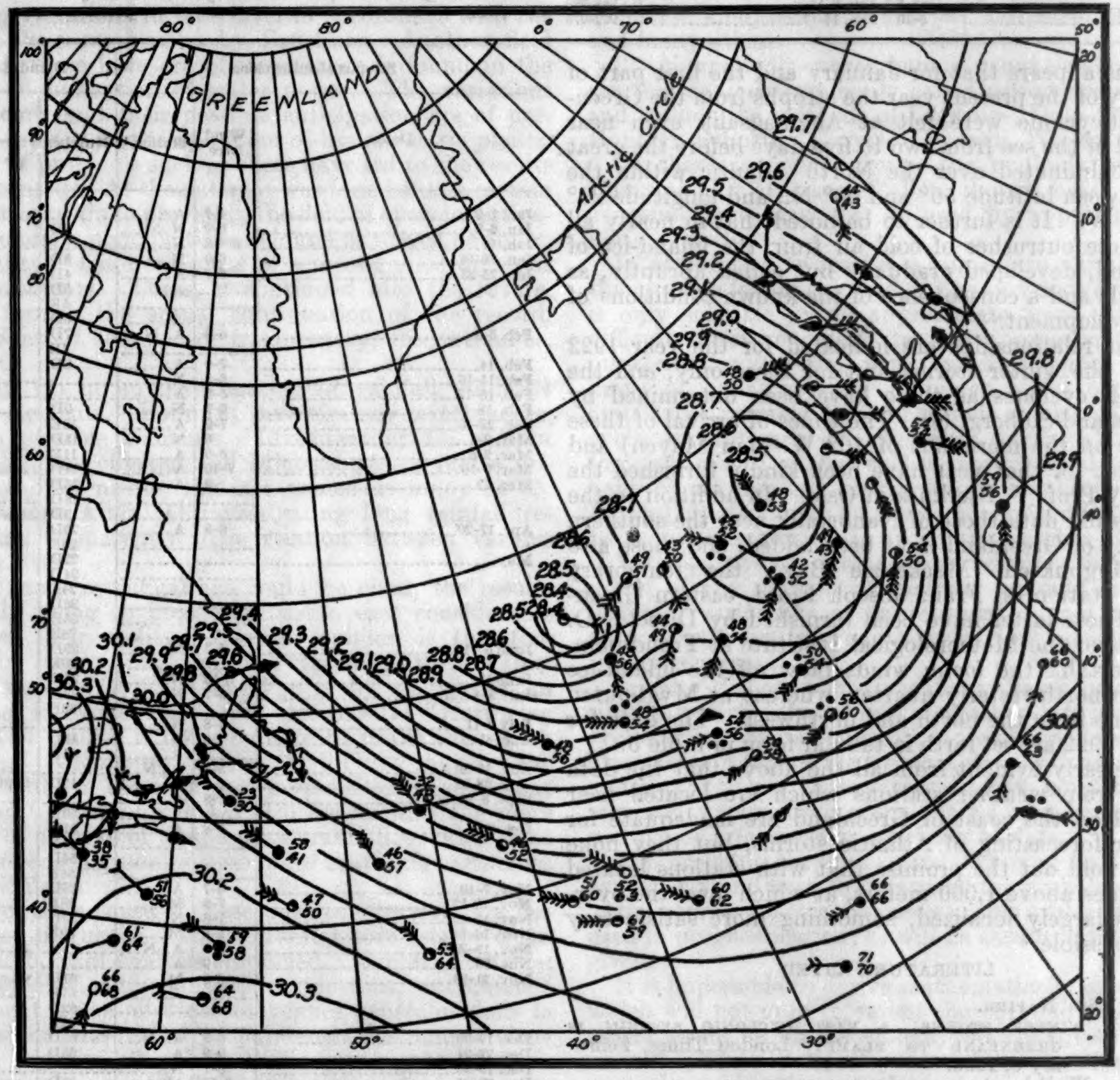

FIG. 1.—Isobaric chart for the northern Atlantic for January 31 (after Young in MONTHLY WEATHER REVIEW)

The twin relations of the strophs from Greenland appear to be confirmed therefore in the storms upon the Atlantic, but with some widening of the interval, as might be expected. A map of the conditions over the North Atlantic on the 31st of January is reproduced from the MONTHLY WEATHER REVIEW in Figure 1. (5)

The data concerning the strophs from the Greenland anticyclone during the first half of the month of February are now available from the station of Angmagsalik. They are as follows:

Study of the synoptic charts for the North Atlantic shows that there were during February no storms comparable with those of January, with the exception perhaps of that which began on the evening of the 15th, the depression of which was located to the southward of Iceland and was represented by a pressure near its center of 972 millibars. This depression remained nearly stationary till the evening of the 17th. Lesser storms occurred within a depression centered near latitude 55° N. and longitude 35° W. between the 9th and

12th, where the pressure varied from 988 to 980 millibars.

On the basis of all the above data the following table has been constructed:

TABLE 4.—*Greenland strophs and Atlantic storms, January 1 to February 15, 1926*

Greenland strophs		Minima of Atlantic storms	
Date	Wind force	Date	Minima
Jan. 2-3	3-9	Jan. 5-6	968-972
Jan. 5-6	3-6	Jan. 9-10	968-956
Jan. 23-24	5-9	Jan. 24-26	968-968
Jan. 26-27	5-9	Jan. 28-Feb. 1	964-952
Feb. 4-5	3-5	Feb. 9-12	988-980
Feb. 13-14	5-10	Feb. 14-17	972-976

It thus appears that for January and the first part of February of the present year the strophs from the Greenland anticyclone were felt at Angmagsalik even near the level of the sea from two to five days before the great storms culminated over the North Atlantic within the area between latitude 50° and 60° N., and longitude 20° and 30° W. It is further to be noted that in nearly all cases these outrushes of cold air from the inland-ice of Greenland, developed gradually but ended abruptly, as is the rule and a consequence of the known conditions of their development.

Similar relationships are indicated for the year 1922 between the winter storms, but for these only, and the D and E cyclones as these have been determined by Bjerknes and Solberg. (*6*) The times of arrival of these cyclones on the meridians of 10° W. (Jan Mayen) and Greenwich for that year have been kindly furnished the writer by Prof. V. Bjerknes of Oslo. In addition to the Angmagsalik data those of Nanortalik near the southern extremity of Greenland have been added, and those also from Mygbukten (Mackenzie Bay), the temporary weather station on Franz Joseph Fjord, eastern Greenland. These latter have been furnished by Director O. Krogness of the Meteorological Institute at Trondhjem. At Nanortalik the foehn winds blow off the inland-ice from the northwesterly quarter, whereas at Mygbukten they come from the north and northwest. The data for the year 1922 are set forth in tabular form in table 5.

It is clearly evident from all the above that the data derived from weather stations which are located near sea level on the coast of Greenland are inadequate for a proper forecasting of Atlantic storms, but they none the less hold out the promise that with stations located at altitudes above 1,000 meters, at which level the overriding is largely localized, something more satisfactory will be possible.

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TABLE 5.—*Strophs of the Greenland anticyclone as recorded at Angmagsalik, Nanortalik, and Mygbugten, compared with the time of arrival of centers of D and E cyclones at longitude 10° W. during 1922*

Strophs of anticyclone			D and E cyclones		
				Day and hour	
Date	Wind force	Station [1]	Number	10° W.	0°
Jan. 1-2	4-7	A			
Jan. 6-9	6-9	N	1D	9^{19}	10^{8}
Jan. 12	8	N			
Jan. 14-15	6-9	N	3D	20^{8}	
Jan. 23-25	6-7	A	4D	25^{14}	
			5D		3^{14}
			5E	4^{19}	
			6D	8^{8}	8^{14}
Feb. 6-8	6-8	A., N	7D	12^{8}	12^{14}
			7E	13^{8}	13^{14}
Feb. 14	7-9	A	8D	16^{19}	17^{8}
Feb. 15-16	6-8	N			
Feb. 16-17	5-8	A			
Feb. 18-19	6-7	N	9D		24^{8}
Feb. 22-23	7-9	A	10E	27^{14}	
Mar. 2-4	6	N	11D	5^{14}	
Mar. 2-5	6-9	A	11E		7^{8}
Mar. 9-10	7-10	A	14D		19^{14}
Mar. 22	9	A	16D	31^{14}	Apr. 11^{8}
			18D		11^{14}
			19D		16^{8}
Apr. 17-20	6-8	A	20D	22^{8}	
			20E	23^{19}	
May			22D	4^{14}	5^{8}
			24D	15^{8}	
			24E	15^{19}	
			26D	26^{8}	
			28D	4^{19}	
			28E	5^{14}	
June 6-11	5-7	N	29D	16^{19}	
			29E	13^{8}	
June 18	8-10	N	31D	22^{14}	
July 3-4	6-7	N	33D	4^{14}	5^{8}
			33E	5^{14}	6^{14}
July 9-11	6-8	N			
Aug. 11	6	N	41D	15^{8}	
			41E	16^{14}	
Aug. 19-20	5-6	A., N			
Aug. 28-29	6-7	N	45D	Sept. 5^{19}	
Sept. 8-10	6-8	A			
			50D	2^{8}	2^{19}
Oct. 6-7	6-9	A	51D	8^{8}	
			51E	8^{14}	
			54D		25^{8}
			54E		27^{8}
Nov. 7-10	6-7	A	58D	13^{8}	
Nov. 10-12	7-9	M	58E		14^{8}
Nov. 11-12	7-8	N	59D		19^{8}
Nov. 16-18	5-6	M	59E		20^{8}
Nov. 19-20	5-9	A., N			
Nov. 20	9	A			
Nov. 21-23	6-8	M	61D	30^{14}	Dec. 4^{8}
			61E		5^{14}
			62D	11^{19}	
			62E	12^{19}	
Dec. 19-20	6-9	A., N	63D	20^{8}	
Dec. 22-24	8-9	A	65D	27^{8}	
Dec. 19-26	6-7	N			
Dec. 20-25	6-10	M	66D	30^{8}	

[1] A, Angmagsalik; N, Nanortalik; M, Mygbugten

ON THE INVESTIGATION OF CYCLES AND THE RELATION OF THE BRÜCKNER AND SOLAR CYCLE

By A. STREIFF, Mem. Am. Soc. M. E.

[Jackson, Mich., June 1, 1926]

The laws of sequence of the weather conditions and the correlation of solar and terrestrial phenomena manifest their importance in constantly arising new problems of far-reaching interest. For instance, a sharp controversy has raged for several years between the States bordering on the Great Lakes and the city of Chicago on account of the diversion of lake water into the Chicago drainage canal, supposedly the cause of the abnormally low lake levels prevailing at present. The question arises however whether or not this is merely another of the periodically recurring variations in lake level in accordance with the climatic cycle established by Brückner. Another field for which these laws are of importance is found in the widespread utilization of water power. The variations of river flow and their possible anticipation are of preeminent interest in the operation of hydroelectric plants.

Study of problems such as these have led to the results here presented. At the outset it was found that a certain confusion appears to prevail in the field of cycle investigation. So many periodicities are found as to cast doubt on their reality. Different parts of a record yield different sets of elements. These, if continued into the future, do not furnish the actual continuation of the record. Correlations, if found, are fragmentary, discontinuous, irregular.

Marvin (*1*) in an investigation of rainfall, finds 24 possible elements. Baur (*2*) investigating temperature, finds 20 possible elements. Investigating the sunpot cycle, Kimura, Schuster, and Michelson each find a different set of elements, the last named as many as 33. (*3*) Dinsmore Alter (*4*) investigating long rainfall records, finds apparently little relation between various localities.

Many more investigations could be cited, the results invariably being so incoherent as to cast considerable doubt on their reality. Adverse opinion is therefore voiced by many investigators regarding their value. Abbott states (*1*) "The speaker is by no means an enthusiast in cycles." Marvin confirms (*1*) "Harmonic analysis, of course, is not adequate to prove the reality of cycles." Clements believes (*1*) "There may be the gravest doubt of the reality of periodicities beyond that of a year." Humphreys (*1*) also insists that the mere analysis of a curve of temperature, rainfall, or other data into a series of harmonics is no proof that such harmonics exist in nature.

The probable cause of these unsatisfactory results has often been discussed. Many investigators ascribe them to the methods of analysis employed. Berget (*5*) states: "Les météorologistes, statisticiens surtout, ont cherché uniquement a compiler des moyennes générales dans la superposition desquelles disparaissent les ondes cherchées." Bigelow (*6*) claims: "The former method (harmonic and periodogram analysis) always leads to zero results in dealing with solar and terrestrial phenomena." Brunt concludes (*7*) "it is clear that the periodogram analysis is not in itself sufficient to deal with temperature variations."

Still others are more specific and point out the reasons why the methods employed are unsatisfactory. Thus Michelson (*3*) speaks of the probability that the cycles are variable, and considers the many homogeneous elements usually found, to be illusory. This theory has been supported by Clough in an important study (*8*), establishing the fact that the variability is systematic. His conclusions are further supported by theoretical considerations given by Marvin (*8*).

The methods hitherto employed in cycle investigations are based on the presence of homogeneous elements. They are (*9*):

(1) Periodic curves, homogeneous elements. These are the methods of harmonic analysis; the 6, 12, 24 point method of Runge, Fisher-Hinnen, Thompson, Turner; the graphical methods of Perry, Wedmore, Ashworth; the harmonic analysers of Michelson and Stratton, Henrici and many others.

(2) Nonperiodic curves, homogeneous elements. These are the methods commonly called periodogram analysis, and include the methods of Lagrange, Dale, Oppenheim, Hopfner, Schuster, Chrystal, Vercelli, Wallén.

Of the last-named group, the methods of Vercelli, Chrystal (*10*) (*11*) and Wallén, though based on homogeneous cycles, can also be used by approximation on variable cycles.

In attempting to resolve a curve into variable cycles, the problem leaves the field of rigorous mathematics, and is only solvable in an approximate way. It becomes difficult, if not impossible, to give a proper mathematical interpretation of the very indefinite premises. The limits of variability are not given. Not only are the amplitudes variable, but the periods as well. Only those cycles which clearly are caused by the earth's motions—the diurnal and annual cycles—are of equal period, but have by no means a homogeneous amplitude. Horace Lamb (*12*) states: "The problem is indeed indefinite, for the solution is possible in an infinite number of ways."

Variable cycles furthermore restrict the resolving power of any method of analysis, for only in case the limits of variability of one element do not too closely approach the limits of another can these elements be distinctly separated.

In spite of these difficulties it may nevertheless be possible to resolve different sets of weather data into variable cycles which constantly recur and which will permit cross identification where the original data will not. Marvin states (*13*) "Only those features which consistently survive and emerge from every analysis can be regarded as real periodic features in any body of data."

The probable limits of variability may be determined empirically and used to determine the probable extension of the curve. In this manner variable cycles may also be used in prognostication, as will be shown in the examples given.

It is impossible to derive mathematically an expression which will not only represent the curve of observations, which would be simple enough, but the future extension as well. There is no way open but to arrive by some general considerations at a hypothetical expression which, though lacking absolute proof, nevertheless seems reasonable. Thus it may be stated that all values are real, and for each value of x only one value of y exists. The curve is univalent, and finite. The curve oscillates repeatedly between rather narrow limits, and we may start by writing the expression

$$y = c_0 + f(t)$$

regarding the ordinate values as oscillating around a constant mean.

Taken over a very long period of time this mean undoubtedly changes; however, these changes are of such a small amplitude compared with the short term variations that they may be disregarded as a first approximation. Enough evidence may be found in the longest available records, such as Douglass' and Huntington's Sequoia record and de Geer's measurements of varvae, as well as the shorter weather records to support adoption of a constant plus a variable portion. From the accompanying Table 1 it may be seen that the variations in the average yearly rainfall at Lund (*4*) do not exceed 4.6 per cent while the individual years vary as much as 40 per cent.

The variable portion oscillates repeatedly between certain limits above and below the mean value. The curve can therefore not be represented by any but some Abelian function having one or more real periods.

Taking only a small part of the curve between narrow abscissae limits $\triangle t$ it is undoubtedly permitted to use the simplest forms, namely the trigonometric functions. From the solutions obtained it appears that the elements it contains are either homogeneous or else damped or increasing oscillations. The constant can of course only be obtained by taking a mean of the longest records available, and in the absence of these no reliable determination of the constant is possible.

Taken over a small period of time the curve can therefore be represented by

$$y = c_0 + \Sigma_1^m c_1 \sin \frac{2\pi}{\theta_1}(t+\phi_1) + \Sigma_1^n c_2 e^{\alpha t} \sin \frac{2\pi}{\theta_2}(t+\phi_2)$$

wherein $C_0 C_1 C_2 \theta_1 \theta_2 \phi_1 \phi_2 \alpha \ldots$ may be regarded as constant values.

In this function the various periodic elements can be separated by repeated integration. Taking the function in three parts, the constant plus a homogeneous cycle plus a damped or increasing oscillation, the integration gives for the constant:

1 integration, $c_0' + c_0 t$

2 integrations, $c_0'' + c_0' t + c_0 \frac{t^2}{2}$

3 integrations, $c_0''' + c_0'' t + c_0' \frac{t^2}{2} = C_0 \frac{t^3}{6}$

It may be seen that the result is a potential series. For the first integration the series is a straight line, but multiple integrations will change this into a curve which will distort the result. It will be necessary to minimize this effect. The second term furnishes—

1 integration, $-\dfrac{c_1}{\frac{2\pi}{\theta_1}} \cos \dfrac{2\pi}{\theta_1}(t+\phi_1) - \dfrac{c_1'}{\frac{2\pi}{\theta_1'}} \cos \dfrac{2\pi}{\theta_1'}(t+\phi_1') - \ldots$

2 integrations, $-\dfrac{c_1}{\left(\frac{2\pi}{\theta_1}\right)^2} \sin \dfrac{2\pi}{\theta_1}(t+\phi_1) - \dfrac{c_1'}{\left(\frac{2\pi}{\theta_1'}\right)^2} \sin \dfrac{2\pi}{\theta_1'}(t+\phi_1') - \ldots$

3 integrations, $+\dfrac{c_1}{\left(\frac{2\pi}{\theta_1}\right)^3} \cos \dfrac{2\pi}{\theta_1}(t+\phi_1) + \dfrac{c_1'}{\left(\frac{2\pi}{\theta_1'}\right)^3} \cos \dfrac{2\pi}{\theta_1'}(t+\phi_1') + \ldots$

It may be seen that the integral is composed of elements which change in phase 90° for each integration, while the amplitudes diminish the faster, the smaller the period. Continued integration therefore tends to eliminate all the elements in the order of their length of period, leaving the longest periods remaining. *It is therefore a selective means of separating the elements.*[1]

The third term furnishes, taking one term of the sum only:

1 integration,

$$c_2\left[\frac{\alpha}{\alpha^2+\left(\frac{2\pi}{\theta_2}\right)^2} e^{\alpha t} \sin \frac{2\pi}{\theta_2}(t+\phi_2) - \frac{\frac{2\pi}{\theta_2}}{\alpha^2+\left(\frac{2\pi}{\theta_2}\right)^2} e^{\alpha t} \cos \frac{2\pi}{\theta_2}(t+\phi_2)\right]$$

2 integrations,

$$c_2\left[\frac{\alpha^2-\left(\frac{2\pi}{\theta_2}\right)^2}{\left\{\alpha^2+\left(\frac{2\pi}{\theta_2}\right)^2\right\}^2} e^{\alpha t} \sin \frac{2\pi}{\theta_2}(t+\phi_2) - \frac{2\alpha\left(\frac{2\pi}{\theta_2}\right)}{\left\{\alpha^2+\left(\frac{2\pi}{\theta_2}\right)^2\right\}^2} e^{\alpha t} \cos \frac{2\pi}{\theta_2}(t+\phi_2)\right]$$

3 integrations,

$$c_2\left[\frac{\alpha^3-3\alpha\left(\frac{2\pi}{\theta_2}\right)^2}{\left\{\alpha^2+\left(\frac{2\pi}{\theta_2}\right)^2\right\}^3} e^{\alpha t} \sin \frac{2\pi}{\theta_2}(t+\phi_2) + \frac{\alpha^2\frac{2\pi}{\theta_2}+\left(\frac{2\pi}{\theta_2}\right)^3}{\left\{\alpha^2+\left(\frac{2\pi}{\theta_2}\right)^2\right\}^3} e^{\alpha t} \cos \frac{2\pi}{\theta_2}(t+\phi_2)\right]$$

It may be seen that the integral is again a damped or increasing oscillation, (α negative or positive) and that the elements again vanish in the order of the length of their periods, the longest period remaining.

For a periodic function the constants may be eliminated by shifting the X-axis over a distance

$$c_0 = \frac{\int_0^{2\pi} y\,dt}{2\pi}$$

before each integration, and repeated integration becomes another method of harmonic analysis, and therefore subject to the same errors if applied to nonperiodic curves with variable elements, in the above manner. For a periodic function the integraph is therefore also a harmonic analyzer.

Applied on nonperiodic functions with variable elements, elimination of the constant in the above manner is no longer permissible as soon as the smaller periods have vanished, for the mean is then largely a mean value

[1] G. G. Stokes, in Proceedings of the Royal Society of London, vol. 29, 1879, pp. 122-23, pointed out the possibilities of an integration method in arriving at the solution of trigonometric functions, but his conception appears to have been essentially that of trial periods, afterwards more fully developed by Shuster. Otherwise, apparently, there is no earlier application than the one outlined herein to the problem of hidden periodicities.—C. F. M

of the ordinates of the element with long period, which may only partly be contained in the graph. The error may then be considerable. In the beginning the amplitude of the shorter elements usually predominates, and an error in the mean caused by the long cycle is usually of small influence.

A further approximation in the case of variable cycles would be found in the use of a record of finite length, for which the above function would not be the correct representation, but would only approximately apply.

For application on nonperiodic curves the integration is therefore extended only over a small part of the curve, as described below. It is of interest, however, to first regard the properties of a single integration, the so-called mass curve.

The mass curve has a distinct physical meaning, for its ordinates represent the total quantity of the subject investigated during a given time interval. Comparing the mass curve with the original curve, it may be seen that the irregularities have largely vanished, the mass curve presenting a much smoother appearance than the original curve. This is evident, as the irregularities, whether real or due to fortuitous errors, are in fact but discontinuous elements of perhaps large amplitude but small period, and a single integration makes these vanish.

The integration is therefore an automatic smoothing process.

The mass curve has furthermore the property that the potential series of the constants is a straight line, and therefore does not distort the curve. Distortion, if any, is due to irregularity or asymmetry of the elements of the original curve, and this is empirically found to be unimportant.

STRATO ANALYSIS

It is important, therefore, to reduce the potential series to a constant if one applies repeated integration. This can be done by integrating in parts, reducing the limits of each integration to a minimum. The trigonometric function is then also a closer approximation. The minimum value between the integration limits, if done numerically, is the interval between two ordinates. The integration is therefore confined to the addition of two successive ordinates, having the abscissae t and $t+\Delta t$.

The addition of two successive ordinates now furnishes

$$y=2c_o+\Sigma_1^m c_1 \sin\frac{2\pi}{\theta_1}(t+\phi_1)+\Sigma_1^m c_1 \sin\frac{2\pi}{\theta_1}(t+\Delta t+\phi_1)+$$

$$\Sigma_1^n c_2 e^{\alpha t}\sin\frac{2\pi}{\theta_2}(t+\phi_2)+\Sigma_1^n c_2 e^{\alpha(t+\Delta t)}\sin\frac{2\pi}{\theta_2}(t+\Delta t+\phi_2),$$

or

$$(1)\quad y=2c_o+2\Sigma_1^m c_1 \cos\frac{\pi\Delta t}{\theta_1}\sin\frac{2\pi}{\theta_1}\left(t+\phi_1+\frac{\Delta t}{2}\right)+$$

$$2\Sigma_1^n c_2 e^{\alpha t}\cos\frac{\pi\Delta t}{\theta_2}\sin\frac{2\pi}{\theta_2}\left(t+\phi_2+\frac{\Delta t}{2}\right)$$

It may be seen that repeated addition again *separates the elements* as the multiplier $\cos\frac{\pi\Delta t}{\theta}$ is larger for a larger period θ.

Inversely, the subtraction of two successive ordinates t and $t+\Delta t$ gives

$$y=-2\Sigma_1^m c_1 \sin\frac{\pi\Delta t}{\theta_1}\cos\frac{2\pi}{\theta_1}\left(t+\phi_1+\frac{\Delta t}{2}\right)-$$

$$2\Sigma_1^n c_2 e^{\alpha t}\sin\frac{\pi\Delta t}{\theta_2}\cos\frac{2\pi}{\theta_2}\left(t+\phi_2+\frac{\Delta t}{2}\right),$$

taking $e^{\alpha\Delta t}\cong 1$.

Repeated subtraction therefore has the opposite effect, as the elements with longer period tend to vanish relative to the elements with shorter period. This is in accordance with the effect of differentiation.

The method, besides being related to Chrystal's and Vercelli's, is also related to the method of Lagrange. In the latter the difference between observations (notation α) are added (notation $E\alpha$) and the following relations are derived

Ordinate, $y=c_o+c\sin(\alpha+r\theta)$

First difference, $\alpha_r=y_{r+1}-y_r=2c\sin\frac{\theta}{2}\cos(\alpha+(2r+1))\frac{\theta}{2}$

1° add. $E\alpha_r=\alpha_{r-1}+\alpha_{r+1}=2\alpha_r\cos\theta$

2° add. $E^2\alpha_r=E\alpha_{r-1}+E\alpha_{r+1}=4\alpha_r\cos^2\theta$

which necessarily are the same proportions as in formula (1).

In the case of variable cycles it is necessary that the interval Δt be considerably smaller than the period of the element to be isolated. The smallest periods obtained are therefore more or less fictitious, if, as is usually the case, the small periods are variable. After the small periods have vanished it becomes permissible to increase the interval between ordinates as an approximation to abridge the work involved.

As before, the phase is to be restored by a shift equal to $m\frac{\Delta t}{2}$, wherein m is the number of additions used. The restoration to scale requires multiplication with $\left(\frac{1}{2}\right)^m$ (m = number of additions).

In order to find the separate elements, the following method is used. After several additions the resultant curve, restored to scale and phase, is subtracted from the original. The difference is called the *stratum*, the remainder the *residual*.

The stratum is given by the formula

$$\Sigma_1^m c_1\left(1-\cos\frac{\pi\Delta t}{\theta_1}\right)\sin\frac{2\pi}{\theta_1}\left(t+\phi_1\right)+$$

$$\Sigma_1^n c_2 e^{\alpha t}\left(1-\cos\frac{\pi\Delta t}{\theta_2}\right)\sin\frac{2\pi}{\theta_2}\left(t+\phi_2\right).$$

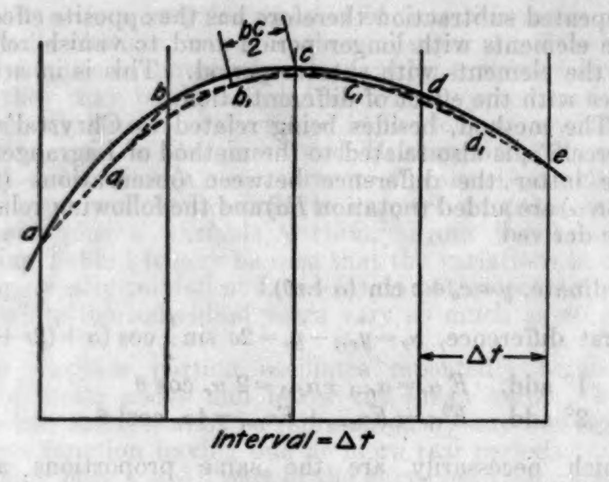
and has important characteristics. It may be seen that the stratum has properties exactly opposite to those of the residual. In the residual the elements with long period predominate, whereas in the stratum the element with short period predominates.

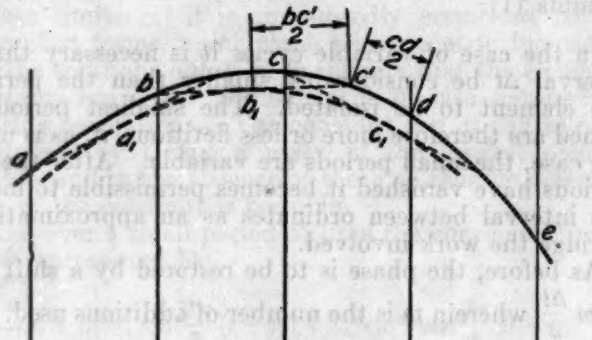
The stratum plainly shows the shorter period, if present, superimposed on a residual, which is similar in outline to, but proportionately smaller than, the second stratum.

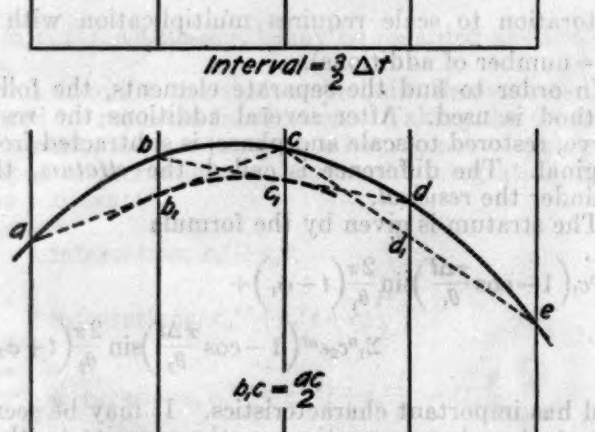
A curve, drawn free-hand, following in outline the second stratum, but of smaller amplitude, isolates the small element from the first stratum. The residual is then added to the next stratum and the process repeated. Finally the various elements are corrected against each other, and their sum necessarily must be equal to the original curve.

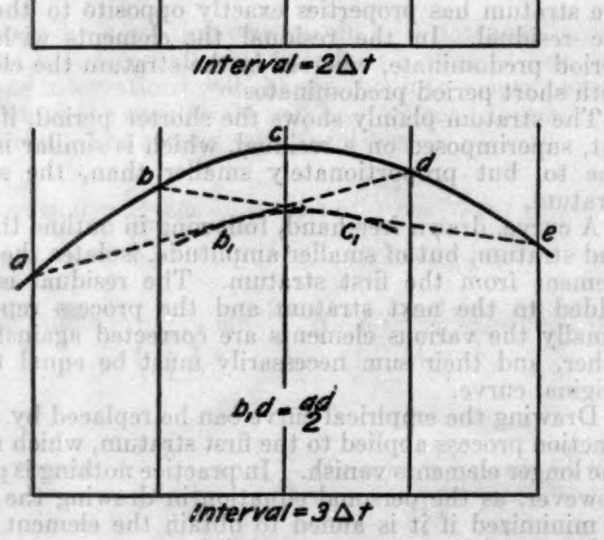
Drawing the empirical curve can be replaced by a subtraction process applied to the first stratum, which makes the longer elements vanish. In practice nothing is gained however, as the personal equation in drawing the curve is minimized if it is aimed to obtain the element to be isolated as homogeneous as possible.

A preliminary trial, with increasing intervals, will disclose quickly the lengths of periods present and the final









number of additions and the interval finally used as one proceeds derived thereform. It should be remembered that for too large values of the interval fictitious values of the variable elements will result.

GRAPHICAL METHOD

Residual and stratum can also be obtained graphically in correct phase by a simple construction. Let a, b, c, d, e, be the points of the original curve. Then a_1, b_1, c_1, d_1, are points of the residual for the interval as shown. The difference between the dotted and the full line is the stratum in correct phase. Calling the interval between two ordinates Δt we have for different values of the interval between ordinates to be added I the following constructions:

ON THE RELATION OF THE BRÜCKNER AND THE SOLAR CYCLE

By applying the foregoing methods a relation between the solar cycle and terrestrial phenomena and with the Brückner cycle is easily demonstrated.

Figure 1 is a graph of the mass curve of the Wolf numbers. It may be seen that a single integration has a smoothing effect, and the long periods in the sun-spot curve become plainly visible. The major elements of the sun-spot curve have hereby been isolated to such an extent that these may be isolated by mere inspection.

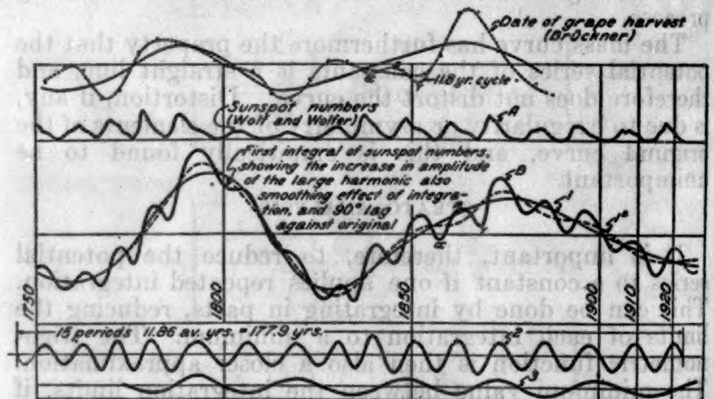


FIG. 1.—Example of integration of Fourier series, sun spot numbers, and their first integral

Drawing the center line through the 11-year cycle, it may be seen that this center line consists of a longer cycle superimposed on the still longer secular cycle.

If now the sun-spot curve be analyzed by means of strato analysis, the same elements necessarily emerge. This is given in Figures 2 and 3. Figure 2 shows the graphical process applied to the sun-spot numbers, using increasingly larger intervals between ordinates. This abridges the work but at the same time introduces a further approximation, since the cycles are variable. The approximation resulting is in this case unimportant. The last residual is transferred to Figure 3 and a curve drawn through the individual points. By continuation of the same process the dotted line in Figure 3 is finally obtained, the 11-year cycle having vanished.

Comparing Figures 1 and 3 and taking into consideration that in Figure 1 the elements are leading by one quarter period, and also considering the difference in amplitude, it may be seen that the results are identical. There appear to be three major variable cycles in the sun spot curve which for identification purposes may be called the Jupiter, Saturn and Secular cycle.

Returning to terrestrial phenomena, a comparison with the levels of the Great Salt Lake and Lake Ontario is shown in Figure 3. The curve for the variation of

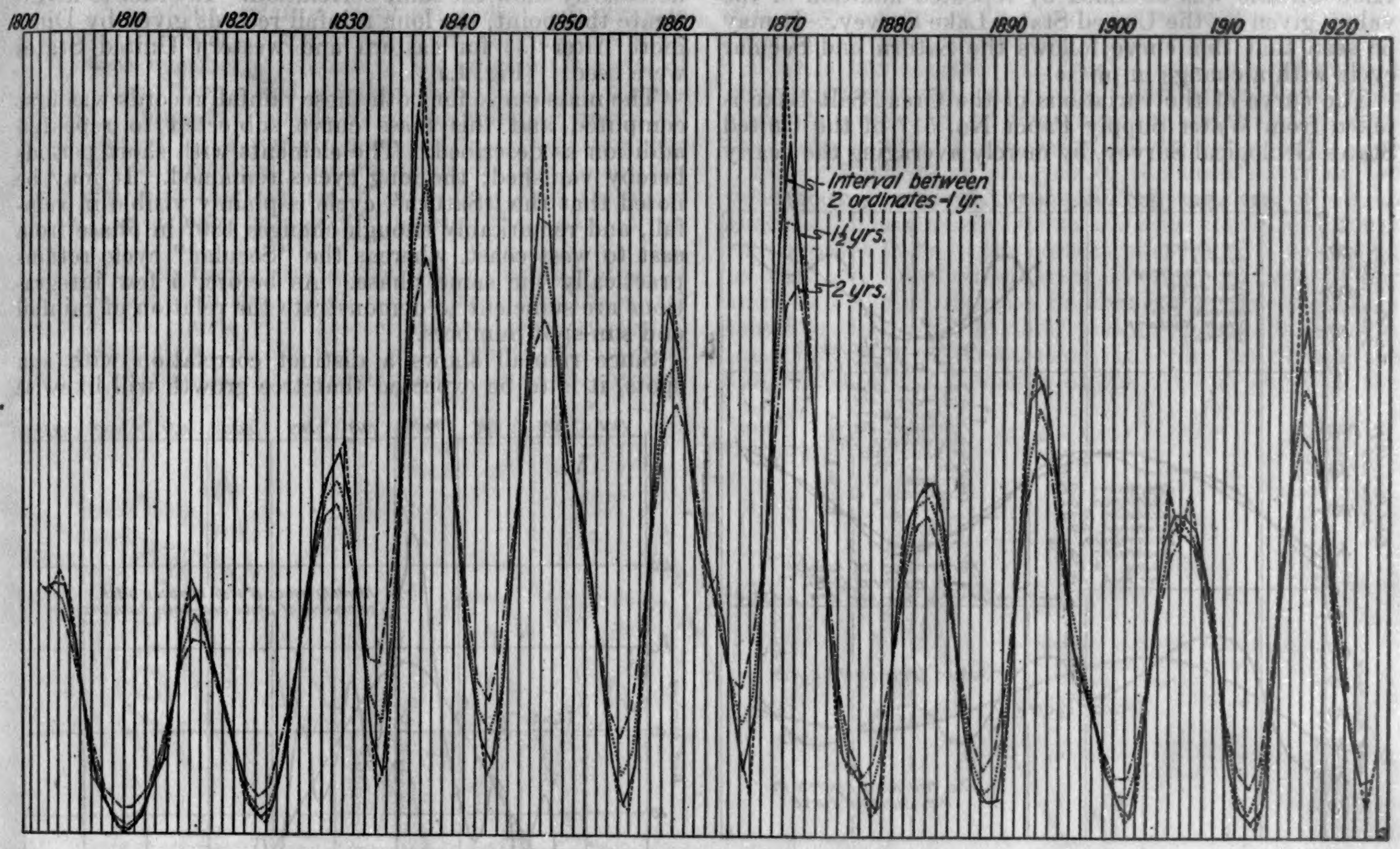


FIG. 2.—Strato analysis of the Wolf numbers

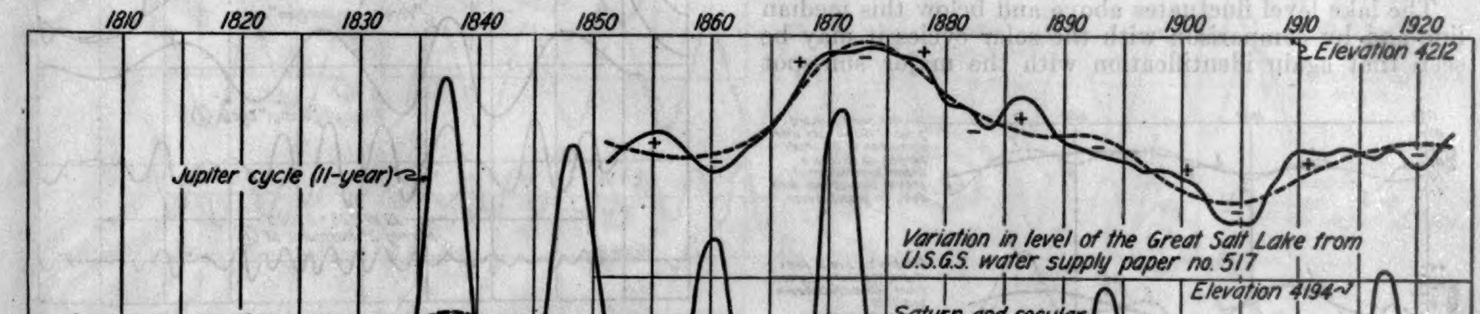


FIG. 3.—Comparison of lake levels and Wolf numbers

Lake Ontario was obtained by repeated addition of the values given by the United States Lake Survey. It may be seen that this curve follows the Saturn and Secular cycle with a change in phase.

The curve of the variations of the Great Salt Lake is taken from Water Supply Paper No. 517 of the United States Geological Survey, by merely averaging the yearly

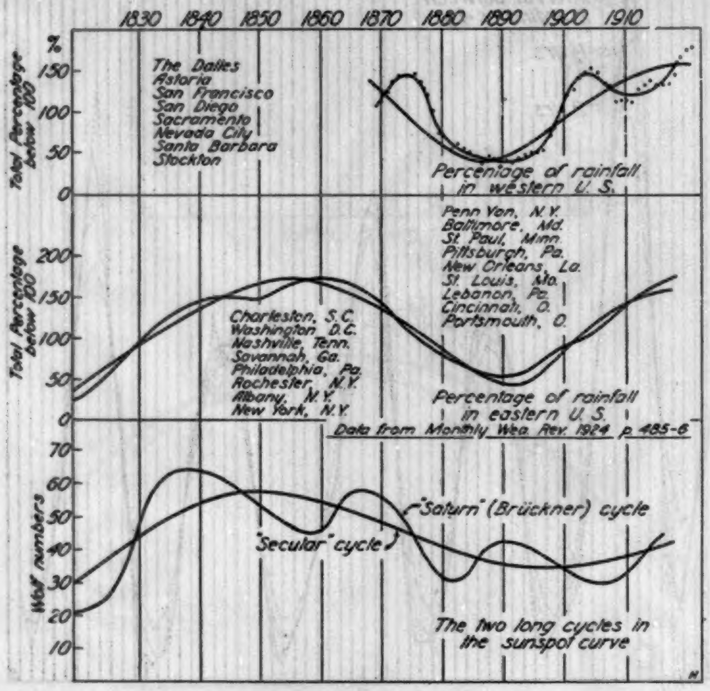


FIG. 4.—Percentage of rainfall in the eastern and western United States and the two long cycles in the sun spot curve

fluctuations. This could be reduced by repeated addition, but since the curve is simple in appearance the results are the same if merely a median curve is drawn.

The lake level fluctuates above and below this median line and by comparison with the solar cycles it may be seen that again identification with the major sun-spot

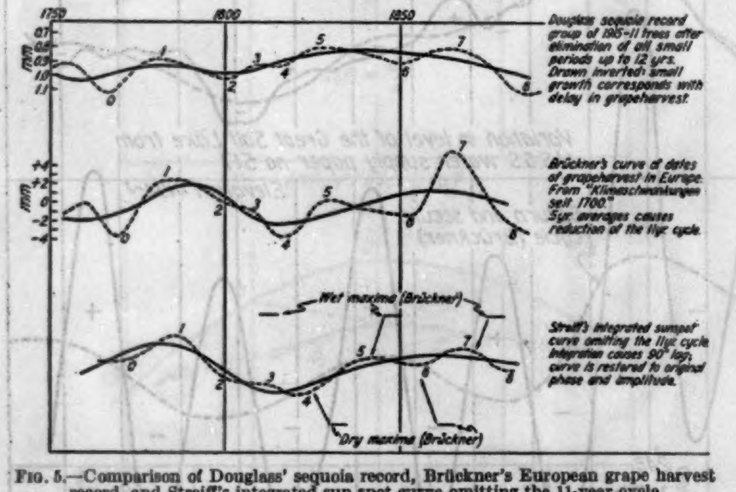


FIG. 5.—Comparison of Douglass' sequoia record, Brückner's European grape harvest record, and Streiff's integrated sun spot curve omitting the 11-year cycle

cycle is possible. A remarkable coincidence is here visible. It appears that the lake level seems to follow also the 11-year cycle, but with a change in phase of about 180°.

It appears therefore that the lake levels change in accordance with the major sun-spot cycles. This being the case, the conclusion may be drawn that rainfall must necessarily show the same correlation. In order to investigate this point, the long rainfall records given by Dinsmore Alter (*4*) for eastern and western United States were used. (Fig. 4.)

The mass curve for both these rainfall records was first computed and this mass curve subjected to repeated addition as described. The elements with short periods hereby vanished; the long cycles remained. It may be noted that the "Saturn" cycle is plainly visible in rainfall, and remarkably enough changes 180° in phase from east to west coast, whereas the "Secular" cycle retains practically the same phase. As before, a few integrations are sufficient to demonstrate the relation of rainfall and sun-spot numbers.

Since rainfall shows a distinct correlation with sun spots, it is to be expected that tree growth will likewise

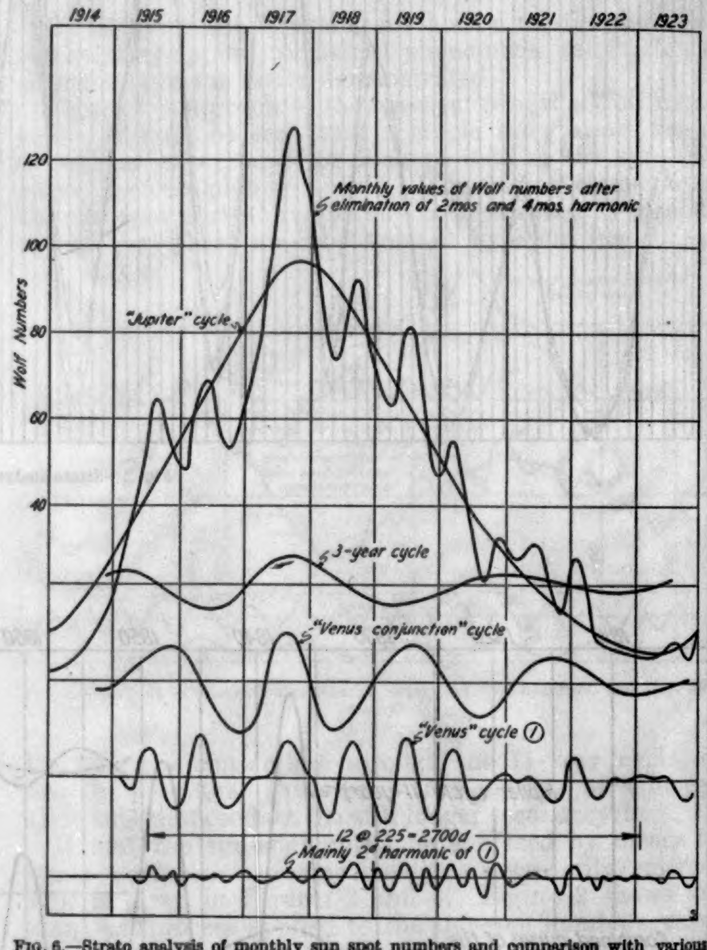


FIG. 6.—Strato analysis of monthly sun spot numbers and comparison with various cycles

show a distinct correlation. In order to test this, Brückner's curve of the dates of the grape harvest in Europe was taken unaltered from the work, "Klimaschwankungen seit 1700." From Douglass's work, "Climatic cycles and tree growth," the Sequoia record was taken. The latter was subjected to repeated addition until the 11-year cycle had vanished.

Figure 5 shows the relation of these two curves with the integrated sun-spot curve. It may be seen that the relation between the Bruckner cycle and the major sun-spot cycles is plainly evident, although the phase changes. The change in phase with geographic location has been emphasized by many investigators, as Baur (*2*) and Huntington (*14*).

As is well known, Professor Brückner investigated the existence of a long-term climatic cycle by tabulating

five-year means of a great amount of various weather data. Since the relation between this long climatic cycle and the long solar cycles is unmistakable, the question arises whether a relation of the smaller elements of the sun-spot curve and weather data could be demonstrated. Since the variations in the sun-spot curve are accompanied by a variation of the solar radiation the influence on terrestrial phenomena should not necessarily be confined to the long solar cycles only, but the short cycles as well may be expected to cast their shadow on earth.

In order to demonstrate this, the monthly values of the sun-spot numbers, which were obtained by the writer through the courtesy of Doctor Abbot, were subjected to strato analysis. (Fig. 6.) On this chart, the smallest cycle (2d harmonic of 1) is largely fictitious, as the interval

for absolute measurements of the amount of precipitation it is very well suited to demonstrate the periodic variations in this weather element.

This is immediately visible if it is attempted to find periodic variations in rainfall and river flow. The cycles in river flow are clear, regular, and distinct, while the cycles in rainfall are erratic in character.

Figure 7 shows an analysis of the mass curve of the Penobscot River, Me., obtained by means of strato analysis. The elements shown are mass curves and therefore in order to be in the correct phase should be shifted to the left over one-quarter of their period. Their amplitude should likewise be changed inversely proportional to the length of their period, in accordance with the effect of a differentiation, in order to obtain the amplitudes of the elements of the original curve in the

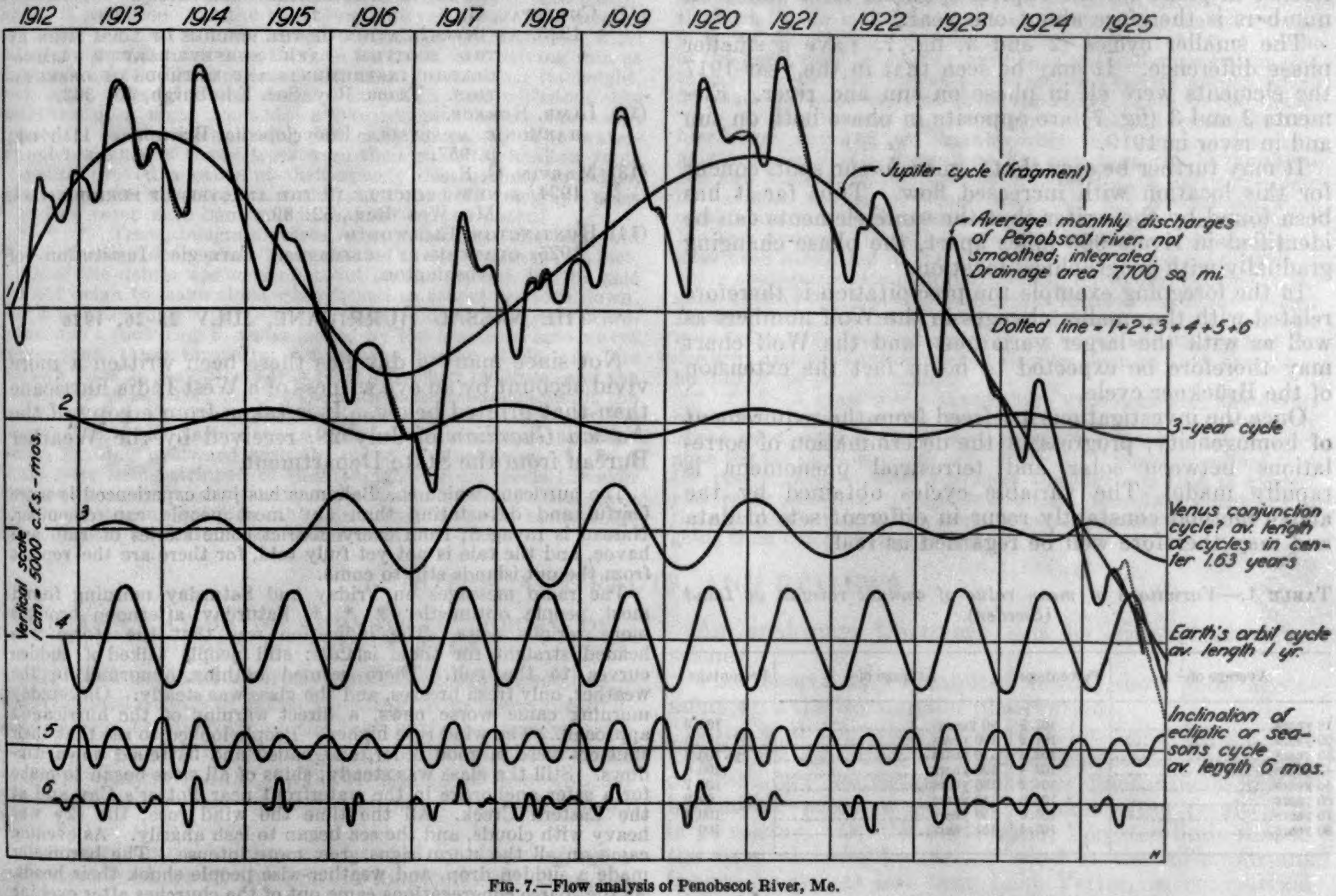


FIG. 7.—Flow analysis of Penobscot River, Me.

of the ordinates was too large for this variable cycle. It may be seen that the Wolf numbers contain four main variable elements. The nomenclature is merely used for easy identification and has no reference to origin. An interesting fact is here visible. Near the sun-spot maximum, all elements appear to be in phase.

In order to demonstrate the relation of these short solar cycles with rainfall, an indirect route was selected. Instead of rainfall, comparison is made with the periodic variations in river flow.

River flow, as an index of precipitation, has an important advantage over the direct measurement by means of a rain gauge. The drainage area may be many thousands of square miles and fortuitous variations may therefore be considered eliminated. The large drainage area acts as an integrator of rainfall; although it can not be used

correct proportion. Thus, taking the amplitudes of 4 as a standard, the amplitudes of 5 should be multiplied by 2, of 3 divided by 1.63, of 2 divided by 3, and of 1 divided by about 7. The amplitudes are then in the correct proportion as they occur in the run-off curve.

Applying strato analysis to river flow, an interesting fact is observed. The sum of the ordinates of 4, 5, and 6 taken over one year is practically zero. These cycles are plainly "terrestrial," due to the earth's motions, and the relative wetness or dryness of the year is independent of these. The yearly cycle, though largest in amplitude of all flow cycles, is practically homogeneous from year to year, and does not influence the relative wetness or dryness of the year.

In order to estimate the relative wetness of the following year, it is therefore only necessary to estimate the

continuation of 1, 2, and 3 which in the run-off curve are rather flat curves, and permit an estimate with a fair degree of accuracy. The river, in this manner, becomes a useful meteorological instrument for the estimate of future storage quantities in irrigation projects.

If now Figures 6 and 7 are compared, an interesting correlation is observed. The annual and semiannual cycles (4 and 5, fig. 7) are absent in the Wolf numbers, which is to be expected. Its place is occupied by a smaller cycle (1, fig. 6) which on the other hand is not in evidence in the river chart. The periods larger than one year appear to be identical for the river and the Wolf numbers.

If the largest cycle (1, fig. 7) is shifted to the left one quarter period, the maximum, which is the true maximum of the run-off curve comes in 1918 and the difference in phase for the Jupiter cycle for river and Wolf numbers is therefore about one year.

The smaller cycles (2 and 3, fig. 7) have a smaller phase difference. It may be seen that in the year 1917 the elements were all in phase on sun and river. Elements 2 and 3 (fig. 7) are opposite in phase both on sun and in river in 1919.

It may further be seen that numerous sun spots concur for this location with increased flow. Thus far it has been found by the writer that the same elements can be identified in rivers 900 miles apart, the phase changing gradually with geographical location.

In the foregoing example the precipitation is therefore related with the smaller changes in the Wolf numbers as well as with the larger variations, and the Wolf chart may therefore be expected to be in fact the extension of the Brückner cycle.

Once the investigations are freed from the requirement of homogeneity, progress in the determination of correlations between solar and terrestrial phenomena is rapidly made. The variable cycles obtained by the above method constantly recur in different sets of data and may therefore well be regarded as real.

TABLE 1.—*Variations of mean value of annual rainfall at Lund (Sweden)*

Average of—	Percentage	Average of—	Percentage
10 years	101.8	90 years	102.2
20 years	101.2	100 years	101.5
30 years	102.2	110 years	100.7
40 years	103.4	120 years	100.8
50 years	104.2	130 years	100.7
60 years	104.6	140 years	99.9
70 years	103.6	150 years	100.4
80 years	103.4	157 years	100

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THE NASSAU HURRICANE, JULY 25–26, 1926

Not since many a day has there been written a more vivid account by an eye witness of a West India hurricane than that printed below. It is taken from a copy of the *Nassau Guardian* of July 28, received by the Weather Bureau from the State Department.

The hurricane which the Bahamas has just experienced is more fearful and devastating than any most people can remember. Nassau is ravaged; from every district come stories of ruin and havoc, and the tale is not yet fully told, for there are the reports from the out islands still to come.

The radio messages on Friday and Saturday morning found most people optimistic. * * * Saturday afternoon brought more serious news. The indication was that the storm was headed straight for these islands; still people talked of sudden curves to the gulf. There seemed nothing abnormal in the weather, only fresh breezes, and the glass was steady. On Sunday morning came worse news, a direct warning of the hurricane's approach. The wind rose higher. People looked to see that their shutters were in good order, and nailed and battened down windows. Still the glass was steady; ships of all sizes began to make for a safer anchorage in the waterfront near Potter's Cay and at the Eastern Creek. All the time the wind rose; the sky was heavy with clouds, and the sea began to lash angrily. As evening came on all the storm signs grew more intense. The barometer made a sudden drop, and weather-wise people shook their heads. As the sparse congregations came out of the churches after evening service it was plain that the storm was near. The wind rushed along Bay Street, swirling leaves and scraps of paper and stray sponges into doorways. The shopkeepers had almost without exception taken the precaution to board up their windows and Bay Street looked ready for a barricade, as indeed it needed to be. The sea came dashing up Rawson Square, throwing spray far over, and the harbor at this part was strangely dark any deserted. Here and there electric lights began to fuse, and street after street was plunged into darkness. Hardly anyone was to be seen, save unfamiliar policemen in long dark coats and storm helmets. People were all at home trying to make their houses additionally secure.

The wind was now blowing a heavy gale, dashing through the trees, and shaking the houses, growing steadily more terrible. Everything that could be shaken loose it began tearing down—shutters, signboards, gates. There was little sleep that night for anyone on the island, just listening to this merciless crashing and

tearing and roaring, and wondering what would be the outcome. The gale brought storms of rain, not ordinary rain, but sweeping storms of water like spray, traveling too swiftly to fall downward. Soon roofs of houses began to tear away, and water was swept in. Some roofs were torn off entirely, and people had to leave everything, stumbling pitifully through the wreckage for shelter elsewhere. Few trees could withstand this tremendous force, and down they came. Worst of all was the turmoil in the harbor. No anchorage was safe for ships on such a night. Bigger vessels kept on full speed ahead, and perilously rode the storm; others dragged their anchors and were seen drifting down the harbor and away to sea; some, it could be discerned, with people on board gesticulating in terror, but few could attempt to aid them. A true estimate can not yet be made, but it is said that over 40 vessels went helplessly adrift in this way. Men swam ashore in a desperate attempt when they felt their ships giving way. The sea boiled and raged, the harbor was no refuge. The tide swept over Bay Street, carrying boats with it, and plowing up everything in its way. When light came the storm was raging at its height and though everyone welcomed the end of that fearful night, it was seen that the worst was not yet over. The coming of dawn revealed a town lashed unceasingly by a pitiless wind intent on demolishing everything in its track, and driving rain as fine as smoke. The hurricane was now approaching its height, and large trees of every description which had withstood the battering of a night went down like ninepins before the awful crescendo which raged during the early morning. The water-logged branches of many trees were their ruin, the shallow roots of palms proved a cause of their speedy destruction; but then, what could be expected to stand when concrete telegraph poles with iron cores were bent and broken off by the dozen? * * * Trees, telegraph wires, corrugated iron, shutters, and debris of every description lay sprinkled in the roadway; in fact, much of the debris was moving about on the ground, for the gale did not deign to leave alone what it had so scornfully torn down. For a quarter of a mile East Bay Street below Murphy's warehouse was a foot deep in water lashed by the hurricane into waves larger than those normally seen in the harbor itself. At the Eastern Parade, Bay Street was totally blocked by trees, and the field was a vast lake. Shirley Street was as impassable as if the bush had been given a hundred years to sprout through the asphalt, while the harbor was a milk-white inferno of turbulent water, running westward with the speed of a millrace. * * * Roofs were being stripped of their shingles as one peels the skin from an orange; the shuttered houses streaming with water gave no sign of the anxious life within, and save for a few hardy wayfarers Nassau seemed a town of the dead.

THE AFTERMATH

Yesterday came calm and sunny, and everyone was out early to see what damage had been done. Nowhere was the force of the storm better illustated than at Fort Montagu. What had been trim lawns and shrubberies and neat paths is now as ravaged as if it had been the scene of modern warfare, with tanks in action. The ground is all torn up; trees are uprooted; there are ruts and sand drifts and the scene is desolate. The Fort Montagu Hotel stands in a lake. A little further east it is even worse with the road itself torn up, littered with trees, and boats cast ashore. The western end of the island is the same. Fox Hill suffered terribly, many of the small dwellings having fallen like playing cards. In Grant's Town there is great distress. The scene has entirely changed, there are so many houses down and trees thrown across the roads, while to add to the hardship there are floods in the streets. A great many people are homeless. Other of the poor people are mourning the loss of their boats, their sole means of livelihood, while others are in fear for safety of their relatives out in sponging vessels or at sea on trips to the out islands. All over the island there is distress and loss, beside which the destruction of many of our beautiful vistas is a small matter. * * * Some of the finest trees in the city have been lost and among them, sad to say, the two tall Caicos palms in the Deanery garden which 50 years ago were reputed to be the oldest palms in the island. * * * The *Firebird* had her engines giving full speed ahead for four hours, and lost two shackles while the hurricane was at its height. One of her officers who has seen typhoons in the China Sea and has also had experience in West Indian hurricanes, said he has seen nothing to equal this. * * * A conglomeration of 65 boats, mostly pleasure craft, is to be seen on the beach near Mathew Avenue. Of 49 boats in the back channel, 42 are said to have been blown out of the harbor. * * * We have heard of many courageous acts performed during the storm, but one of the most outstanding was that of Captain Richardson, of the dredger *Lucayan*. He, it is said, saved over a dozen lives. People who were being swept past on sloops clung to the forestructure of the dredger, and the captain rushed to save them as they came, unheedful of the peril to himself.

* * * A great many automobiles were damaged, the covers being shred to ribbons and the enamel "burnt" off by the velocity of the wind; exposed paint work generally seemed to have undergone the fire of blow lamps. * * * It is generally agreed that the best roofing to resist hurricane onslaughts is that of cypress and cedar shingles, though few houses remained entirely dry throughout the storm. In some houses umbrellas were used when going from one room to another.

NOTES, ABSTRACTS, AND REVIEWS

THE APPLICATION OF CHRYSTAL'S THEORY OF SEICHES TO LAKE VETTER

The mathematical hydrodynamical theory of seiches—the free oscillations of lakes resulting from some disturbance of the equilibrium of the lake surface—was worked out by Chrystal (*1*). F. Bergsten, "The seiches of Lake Vetter," Geograf. Ann., 8, 1–73, 1926, has now applied Chrystal's theory to the calculation of the seiches on Lake Vetter in Sweden.

The longitudinal seiches are treated by drawing, on a bathymetric chart of the lake, a longitudinal axis; at a number of points along this axis, transverse cross sections of the lake are taken, spaced according to the rapidity with which the configuration of the bottom is changing; the area of each cross section is multiplied by the breadth of the lake at that point, and these products are plotted as ordinates against, as abscissae, the area of the portion of the lake surface between the origin (at one end of the lake) and the corresponding cross section. The resulting curve, called the "normal curve" of the lake, is then fitted (in sections) by a combination of straight lines, parabolas, and quartic curves.

The hydrodynamical equations of motion can now be integrated; and from the solutions the exact periods of the uninodal and various plurinodal longitudinal seiches, together with the positions of the nodal and ventral lines and the relations connecting the simultaneous heights of the water at different stations can be calculated.

An analogous treatment can be given transversal seiches.

The theoretically computed results show good agreement with the limnometer observations.

Forel and Chrystal found that for Lake Léman and Loch Earn the effect of winds in generating seiches was of secondary importance, whereas fluctuations in the barometric pressure over these lakes often resulted in large seiches. On the other hand, Bergsten finds that in the case of Lake Vetter the wind is the all-important factor; he points out that Lake Vetter, in comparison with its great area, is very shallow, and that in such a shallow lake the wind effect is the most important, whereas in a deep lake the wind effect would not ordinarily be of much importance. The effect of the wind in piling up the water in Lake Vetter is calculated by Hayford's method, and the potential energy thus stored up is shown to be adequate to account for the seiches often observed to follow such a piling up when the wind dies down or changes direction. Only very rarely is it possible to discover any connection between seiches on Lake Vetter and microbarographic records. It is found, by the method due to Hayford, that Lake Vetter would react to pressure changes in a practically static manner.

Bergsten concludes that there seems to be no doubt that the energy necessary for the generation of the seiches of the greatest magnitude on Lake Vetter is produced as a rule by the tangential traction of the wind against the lake surface; standing waves of great ampli-

tudes may directly arise from the steady state by a sudden change in the wind, either abatement or turning through an angle of about 90°; also, with a still greater change of angle, under otherwise similar conditions, the amplitude would be much greater, and the origin of the most important seiches ever observed may be explained in this way. Continuous changes of the relative atmospheric pressure between the two ends of the lake may also be the origin of seiches, but with small amplitudes as a rule; the microbarographic disturbances are of still less importance.—*E. W. Woolard.*

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SIMPSON ON THE VELOCITY EQUIVALENTS OF THE BEAUFORT SCALE[1]

The question of suitable velocity equivalents for the Beaufort scale has been pressing for solution many years. Two solutions have been proposed and fully considered, one by the Deutsche Seewarte,[2] the other by the British Meteorological Office.[3]

Dr. C. G. Simpson after presenting a thorough analysis of both proposals submits a table of equivalents as shown in Table VI below and concludes with the recommendation printed in the closing paragraph below.

TABLE VI.—*Proposed code scale for wind velocity*

Code No.	Limits of velocity		Code No.	Limits of velocity	
	Meters per second	Miles per hour		Meters per second	Miles per hour
0	0-0.5	0-1	6	9.9-12.4	22-27
1	0.6-1.7	2-3	7	12.5-15.2	28-33
2	1.8-3.3	4-7	8	15.3-18.2	34-40
3	3.4-5.2	8-11	9	18.3-21.5	41-48
4	5.3-7.4	12-16	10	21.6-25.1	49-56
5	7.5-9.8	17-21	11	25.2-29.0	57-65

CONCLUSIONS AND RECOMMENDATIONS

(*a*) There is no unique relationship between wind velocity as recorded by anemometers and estimates made on the Beaufort scale.

(*b*) Wind velocities measured by anemometers can be converted into Beaufort numbers only if the equivalent velocities appropriate to the exposure of the anemometer have been previously determined. The Seewarte has determined a satisfactory set of equivalents for anemometers having one type of exposure and the meteorological office another set of equivalents for anemometers with a much freer exposure.

(*c*) It is recommended that when wind velocity is measured by an anemometer the velocity should be reported in weather telegrams by the code set out as Table VI. If this code is used no difficulty will be experienced when the code numbers are plotted on synoptic charts along with Beaufort numbers.—A. J. H.

[1] Air Ministry, Meteorological Office, Professional Notes No. 14.
[2] Koppen: *Aus d. Arch Seewarte*, Hamburg, vol. 21, 1898, No. 5.
[3] Simpson: London, Meteorological Office, Publication No. 180, 1906.

A WISCONSIN TORNADO[1]

W. P. STUART

A tornado first seen in Bayfield County, Wis., within a few miles of Lake Superior at 6.15 p. m. July 16, moved thence in a southeasterly direction and was last seen near Clear Lake, Vilas County, Wis. The length of its path was about 85 miles and its width varied from 300 to 1,760 feet and in places the width of the path of damage was said to have been 6 miles. This extraordinary width seems to have been the width of the path of damaging winds, which may have been straight winds, as they were at Port Wing near the origin of the storm. A funnel cloud was observed at a number of places along the storm's path. Details as to loss of life and property will be found in the table on page 311, this REVIEW.

[1] Condensed from the author's report.—*Editor.*

The tornado passed through the center of the experiment farm at Ashland Junction and was observed by Prof. A. J. Delwiche, of the University of Wisconsin, to whom we are indebted for the following account:

Storm clouds appeared in the west-northwest at 6 or 6.30 p. m. The storm appeared as though it would pass over territory north of here, when in the northwest more clouds collected. Balloon like clouds appeared above, giving the surface a rolling appearance, our first evidence for a possible wind storm. A black layer below moved toward us. Above it the very narrow funnel cloud appeared, a narrow white streak in the black clouds. It was high and had not touched the ground as yet. It was several miles away. The black clouds rolled overhead, then they appeared to move northward, then again south to southwest. The wind began to blow, carrying dust and sand with it. The air was black with dirt and dust. The funnel could be seen coming nearer and nearer in the north-northwest, probably due to the position at which it was viewed, because the path of the funnel passed in a southwest direction.

As the funnel passed its nearest to us the side winds carried everything in its way; the buildings shook from the side winds. Trees were broken in an eastward direction to the north of us, and in a southward direction to the west of us. In the tornado path, 5 miles from here to the northwest, the first destruction took place. The first farmer lost all barn buildings without injury to horses. House was destroyed, tall pine and maple trees were uprooted, broken and twisted about. Next farms, the buildings were taken completely; a timber strip was broken off at heights above the ground of 10 to 20 feet. Farm buildings were wiped out completely as the storm proceeded onward and passed through this section (Ashland Junction), tearing up telephone and telegraph wires, and blocking highways. Then onward to the southwest where two girls were killed, and other homes destroyed for a distance of 5 miles from here. Then the storm did not tear up as many buildings. This is as the storm appeared to us here at the experiment station, and the destruction of the near-by area.

HEAVY RAINS IN VARIOUS PARTS OF THE WORLD

Press reports throughout July carried many references to torrential rains and destructive floods in sundry parts of the world. At best these reports are based on somewhat meager information and deal with the spectacular rather than the scientific aspect of the natural phenomena involved.

NORTH AMERICA

Flood-producing rains fell during the early part of the month in the Mexican States of Sonora, Sinaola, and Nayarit; as a consequence the vegetable crop for export to the United States was cut in half at a loss estimated at $7,500,000.

In the Valley of Mexico extending from about 200 miles north of Mexico City south to the Isthmus of Tehuantepec torrential rains fell almost daily during the early part of the month, causing much damage and suffering. On July 6 it was said:

The greater part of the lowlands of the Valley of Mexico are flooded—something that has not happened in a quarter of a century. From the heights above the town of Tacabaya, south of the capital, the whole Valley of Mexico east to the mountains appears to be a great inland lake. Apparently there has been complete destruction of crops throughout the Mexican Plateau and the loss is estimated at from 10,000,000, to 15,000,000 pesos.

The above is in addition to the loss first enumerated.

SOUTH AMERICA

Dispatches from Santiago, Chile, announce that 18 inches of rain have fallen within a month (probably June, 1926), and that on July 7 Chile was under the influence of the greatest cyclone ever known.

Mendoza, Argentina, July 15.—According to officials of the trans-Andean Railroad, communication between Argentina and Chile has been interrupted by snow and cold and will not become normal until September.

EUROPE

In the June REVIEW mention was made of heavy rains in central and western Europe; since then the rains seem to have continued, particularly in the basin of the Danube and its tributaries as the following indicate.

Belgrade, July 3.—The worst flood in a century is now occurring in all lower quarters of the Yugoslavia Kingdom. Continued heavy rains here and throughout central Europe are rapidly increasing the flood disaster. In southern Serbia thunderstorms have been accompanied by torrential rains; the Vardar quickly rose 22 feet above normal, sweeping away many bridges, houses, and their contents.

Berlin, July 6.—Cloudbursts were reported throughout Germany last night, flooding streets, destroying crops and railways. The Coburg, Passau, and Hirschberg, Silesia, districts suffered the most.

Belgrade, July 23.—Seven villages have been destroyed through the bursting of dams in the Batchka region due to the flood in the Danube, which has now lasted three weeks. The Minister of Agriculture estimates the loss up to the present at $50,000,000.

JAPAN AND AUSTRALIA

Tokyo, July 23.—More than 400 houses have been demolished in Onai, Korea.

Tokyo, July 28.—One hundred persons were drowned at Tochio, Niigata prefecture.

Sydney, July 23.—According to a Sydney dispatch to the London News extensive floods have occurred in western Australia.

Making due allowance for lack of details and possibly some exaggeration it would appear that in some parts of the world the year 1926, thus far at least, has been characterized by a great amount of rainfall.

In the United States and Canada thus far, the year has not been one of greater than the normal rainfall, in fact severe drought has prevailed in parts of the United States. Advocates of the Brückner cycle of wet and dry years may see in the present year a recurrence of the world-wide rains of the early eighties, although the average date of the epoch of wet years fell in 1920, six years ago.—*A. J. H.*

A FRENCH METEOROLOGICAL DICTIONARY

The National Meteorological Office of France has brought out Part I of what is destined to be a large and very important work, the Lexique Météorologique, under the editorship of M. Baldit. The necessity for and purpose of the work is thus set forth by M. Delcambre, director of the office:

The need, in a modern national meteorological organization, for a dictionary of the type now in preparation at the National Meteorological Office, became evident to me in 1916 in the course of the war, when the rapid development of military aeronautics imposed ever-increasing obligations upon the meteorological service, and hence made necessary the erection of increasingly numerous and active observing stations. This multiplication of stations demanded, in turn, the rapid building up of a personnel capable of making the customary meteorological observations and, if need be, of analyzing, discussing, and even making practical use of them.

By the very nature of the problems which aeronautics set up, the teaching of meteorology became perforce an important phase of the work of the national meteorological service.

Similar conditions recurred after the war, when the inception and development of commercial aeronautics brought the same difficulties and the same obligations; but, the necessarily hurried teaching of the personnel, the impossibility of giving it a complete course of instruction—which would be impossible anyway, on account of the constant progress of meteorology—and the isolation of the personnel on stations scattered throughout the territory, emphasized the need, even more imperatively than during the war, of providing the observers with a guide which, in lieu of a teacher, would enable them to round out the instruction received during their residence at the school.

Moreover, meteorologists, to be worthy of their title, must read scientific publications dealing with the physics of the earth. Now, those publications contain a special terminology and are based upon scientific theories or results, a knowledge of which usually requires the reading of numerous papers which one may find collected in but few libraries. So for these reasons, also, it becomes imperative to supply the station personnel with bibliographic materials which will render unnecessary extensive and difficult research on their part.

The comprehensiveness of the dictionary may be judged from the fact that the treatment of subjects in Part I, abacus to bolometer, occupies 58 pages exclusive of numerous plates. Illustrations are abundant.

It is announced in the preface that there is to be included a vocabulary in six languages, of which Esperanto will be one. In view of the increase in number of meteorological terms, this vocabulary will be not the least useful part of the work.—*B. M. V.*

CORRELATION BETWEEN ARGENTINE PRESSURE, AND TEMPERATURE IN UNITED STATES SIX MONTHS LATER

Mr. Fritz Groissmayr, Passau, Bavaria, sends the editor the results of his computation of the correlation coefficient between May pressure at Cordoba and Buenos Aires, and the temperature of the following autumn at five stations in the eastern United States. Data used in the computations are given below. The meanings of the symbols $\Delta p.V$ and $\Delta tIX\text{-}XI$ in the columns of the subjoined table are: $\Delta p.V$ = (deviations in May from normal pressure at Cordoba + Buenos Aires) ÷ 2; $\Delta tIX\text{-}XI$ = (deviations in autumn from normal temperature at New York + New Orleans + Cincinnati + Milwaukee + St. Louis) ÷ 5.

Year	Δp. V	ΔtIX-XI	Year	Δp. V	ΔtIX-XI	Year	Δp. V	ΔtIX-XI
	Mm.	° *C.*		*Mm.*	° *C.*		*Mm.*	° *C.*
1874	1.9	−0.1	1891	−0.3	−0.7	1908	1.2	1.5
1875	−0.6	−3.5	1892	2.8	−2.1	1909	1.7	1.1
1876	−0.5	−3.1	1893	0.6	−0.6	1910	2.0	−0.1
1877	0.1	−1.5	1894	0.1	−0.4	1911	−0.2	−0.6
1878	0.5	0.0	1895	1.4	−0.9	1912	−0.2	1.4
1879	0.6	0.5	1896	1.8	−1.0	1913	−0.5	1.0
1880	−0.2	−2.2	1897	−0.6	2.5	1914	−0.5	1.3
1881	−1.5	2.7	1898	−0.7	−0.3	1915	−3.1	2.2
1882	−1.1	1.3	1899	−1.8	2.0	1916	−0.4	−0.2
1883	0.0	−0.2	1900	−0.1	2.3	1917	3.7	−3.4
1884	1.0	1.7	1901	−1.1	−0.3	1918	0.0	−0.6
1885	−0.7	−1.7	1902	−2.3	1.9	1919	−3.1	1.7
1886	0.1	−0.2	1903	1.3	−1.2	1920	−2.1	1.4
1887	2.3	−1.9	1904	0.8	0.3	1921	−1.9	2.2
1888	−1.7	−2.1	1905	−0.1	0.3	1922	−0.4	2.4
1889	−0.3	−2.4	1906	−2.1	1.0	1923	1.4	−0.3
1890	1.2	0.2	1907	1.6	−1.2			

The correlation coefficient $r = -0.46 \pm 0.075$; regression equation: $\Delta tIX\text{-}XI$ eastern U. S. $= -0.51\ \Delta pV$.—*A. J. H.*

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR THE FIRST HALF OF 1926

(Reprint from A. Wolfer, in *Meteorologische Zeitschrift*, April and July, 1926)

1926	Jan.	Feb.	Mar.	Apr.	May	June	1926	Jan.	Feb.	Mar.	Apr.	May	June
1	93	-----	-----	35	62	62	18	-----	85	70	63	71	52
2	-----	42	68	30	53	73	19	-----	-----	69	75	80	50
3	60	38	103	29	56	45?	20	-----	67	46	58	63	52
4	37	41	103	29	68	-----	21	103	59	38	41	75	44
5	-----	34	119	22	86	80	22	-----	41	-----	35	67	37
6	56	29	-----	23	53?	-----	23	102	48	-----	14?	40	52
7	52	35	100	30	74	95	24	-----	49	35	14	27	55
8	76	44	-----	27	102	86	25	124	64	37	16	31	-----
9	90	-----	82	49	92	92	26	-----	-----	45	-----	22	86
10	92	-----	63	29	88	88	27	78	53	45?	14	23	88
11	84	99	47	34	93	94	28	40?	-----	17?	19	43	99
12	69	97?	-----	37	89	62	29	-----	-----	30	41	54	106
13	57	142	45	58	-----	75	30	48	-----	31	39	52	109
14	55	150	58	71	60?	80	31	21	-----	-----	-----	50	-----
15	-----	162	89	65	86	57							
16	-----	-----	107	69	84	65	Means	71.6	69.0	63.6	39.1	63.6	71.6
17	94	-----	79	69	65?	48							

A RELATION BETWEEN HIGH RATES OF EVAPORATION AND WESTERN YELLOW TOMATO BLIGHT

In *Phytopathology* for August, 1925, Mr. Michael Shapovalov presents the results of an investigation into this subject. The following excerpts embody the conclusions reached:

In the case of western yellow tomato blight, a certain seasonal march of evaporation means a definite progress of blight in the same season. This disease causes serious annual losses to the growers over a large territory extending west of the Rocky Mountains to the Pacific coast and from British Columbia to the west coast of Mexico, but the actual annual damage fluctuates according to seasonal conditions. The summer of 1924 was marked by a particularly severe outbreak of western blight in a number of widely separated regions of the West and for this reason is especially interesting. This outbreak correlates with an unusually high evaporation in all those sections in which it occurred. * * * The rate of evaporation in 1924 was in every case above the average of a number of preceding years. * * * The amount of the disease in California varied from practically nothing in humid regions near the coast to nearly 100 per cent in localities with a high rate of evaporation. * * *

The most striking correlation between the amount of blight and the rate of evaporation was observed on the experimental plots at Shafter, Calif., and at Riverside, Calif., where counts of blighted plants were made throughout the season. The disease developed slowly and in very small amounts with the lowest evaporation curve at Riverside in 1923. It was more severe in 1924 when the evaporation was higher, but the most serious attack and in much shorter time developed with the highest rate of evaporation at Shafter in 1924.

The comparison of the percentages of blight at Riverside and at Shafter in 1924 indicates that the rate of evaporation is not only concomitant with the severity of blight in different seasons in the same locality, but also correlates with its geographical distribution. * * *

Blight areas during the principal blight period seem to have the average monthly humidity below 35 per cent, while nonblight areas about or above 50 per cent. The extremes for each group are to be found in the San Joaquin Valley for the former, and near Vancouver and San Diego for the latter. High evaporation is not only attendant on, but also foreruns severe spells of blight, especially at the outset of the season. * * * Detailed weekly observations (at both Riverside and Shafter in 1924) from the time the plants were set out in the field show very distinctly that the first serious waves of the disease were preceded by marked rises in the rate of evaporation.

METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA, JUNE, 1926

By J. BUSTOS NAVARRETE, Director

[Observatorio del Salto, Santiago, Chile]

The month of June was the rainiest recorded in the central zone of Chile since the year 1873 to date. In the comparative table herewith are given the amounts of precipitation for the very rainy Junes since 1873 at Santiago. In the other years the June rainfall was less than 100 millimeters.

Year	Millimeters	Inches	Year	Millimeters	Inches	Year	Millimeters	Inches
1880	234.6	9.23	1899	235.4	9.27	1912	124.5	4.90
1887	159.8	6.29	1900	130.3	5.25	1914	205.5	8.09
1888	127.0	5.00	1901	109.7	4.31	1919	139.5	5.49
1891	149.3	5.88	1902	150.4	6.08	1922	215.8	8.49
1898	243.0	9.57	1905	186.0	7.32	1926	442.4	17.40

The month was characterized by very active atmospheric circulation. Between the 3d and 5th a large depression affected the country between Coquimbo and Chiloe, with violent winds and rains. The maximum precipitation in 24 hours was observed on the 5th at Talca, 53 mm. From the 6th to the 8th there was a temporary calm.

On the 9th an enormous depression appeared in the west. On the 10th the storm broke over the whole central zone, affecting mostly the port of Valparaiso. Precipitation varied between 20 and 30 mm. On the 11th it was again calm.

On the 12th another depression affected the southern zone of Chile. It rained in torrents. At Valdivia was observed the maximum precipitation in 24 hours, 137.8 mm. This caused high river stages and floods. Weather from the 13th to 15th was unsettled.

On the 16th a large depression appeared off the central zone of Chile, and between the 17th and 20th there developed a period of general bad weather, with violent winds and torrential rains. Floods occurred in the central zone and rivers were out of their banks. At Santiago the maximum precipitation for 24 hours (on the 18th) was more than 70 mm.

Between the 21st and 24th there was a stationary depression off Punta Tumbes, which caused renewed bad weather with rains between Aconcagua and Valdivia. Maximum precipitation in 24 hours was 73 mm. on the 23rd at Punta Tumbes. On the 24th the depression filled up, in harmony with the laws of Guilbert.

The 25th was fine, and the 26th cloudy with a cold wave.

From the 27th to the 30th another enormous depression affected the country, developing a new period of bad weather. At Punta Tumbes the wind velocity exceeded 1,700 m/m (63 m/h), and there were heavy breaking seas. It rained in torrents from Coquimbo to Chiloe. There was a general rise of the rivers from Aconcagua to Maullin, and renewed floods.

To summarize, the month of June, 1926, was the rainiest and stormiest which has been recorded in Chile since the beginning of meteorological observations.—*Transl. B. M. V.*

METEOROLOGICAL SUMMARY FOR BRAZIL, MAY AND JUNE, 1926

By FRANCISCO SOUZA, Acting Director

[Directoria de Meteorologia, Rio de Janeiro]

May.—The atmospheric circulation in the lower strata remained abnormal during the month; the continental depression was very active, as were also those of high latitudes.

The anticyclones which invaded the southern part of the country moved less directly from south to north than usual, whence the fact that the temperatures were more moderate than those of the previous month.

In the northern part of the country, rains were scant, their mean being 2.8 mm. below normal. In the central part, the observed rainfalls were somewhat above their respective normals, the average plus departure being 53.1 mm. The rains in the south were scattered.

Progress of crops remained in general good, though the yields were irregular. Due to deficiency of rainfall in the north, the yield of beans was reduced, as also that of corn, which in some places was 50 per cent short.

The state of the weather in Rio de Janeiro was in general mild. Cloudiness was slightly below normal. Temperatures remained somewhat low, giving values which were on the whole a little below the respective normals. South to east winds of moderate velocity prevailed. On the early morning of the 15th, there was a heavy squall from WSW. with a maximum velocity of 19 m/s.

June.—The secondary circulation remained rather active, the country having been swept by five anticyclones which moved along inland paths and in low latitudes and caused noticeable drops in temperature. Frosts were observed rather generally in the southern part of the country during the second half of the month.

For the country as a whole, rainfall was not very abundant, almost all the totals remaining below their respective normals. Due to rainfall deficit in the Amazon Basin, navigation on the rivers of that region was seriously interrupted, resulting in great detriment to commerce.

The progress of coffee, cotton, cane, rice, tobacco, wheat, corn and beans remained satisfactory, while the yield of cotton and cane were excellent. Coffee suffered a little from frosts during the latter days of the month; yields were, however, normal.

The weather in Rio de Janeiro was in general good, there being recorded only five cloudy days and three days with measureable precipitation. Mean temperature remained somewhat above normal, notwithstanding the fact that the mean minimum was 0.2 of a degree below normal.—*Transl. W. W. R. and B. M. V.*

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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING JULY, 1926

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1924, **52**:42, January, 1925, **53**:29, and July, 1925, **53**:318.

From Table 1, it is seen that solar radiation intensities averaged slightly below the normal for July at all three stations.

Table 2 shows a deficiency in the amount of radiation received on a horizontal surface from the sun and sky, which was pronounced at Washington.

Skylight polarization measurements made on 5 days at Washington give a mean of 53 per cent, with a maximum of 56 per cent on the 12th. Measurements made on 6 days at Madison give a mean of 49 per cent, with a maximum of 65 per cent on the 14th. These are close to the corresponding averages for July at Washington and below at Madison.

TABLE 1.—*Solar radiation intensities during July, 1926*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass A. M.					Air mass P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	1.0[1]	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
July 1	9.83				0.78	1.06					11.38
7	16.79				0.60	1.38	0.99	0.62			13.13
8	11.38			0.63	0.90						11.38
10	19.23				0.98						18.59
12	9.83		0.84	0.97	1.11	1.40	1.05	0.67			8.81
16	11.81		0.60	0.74	0.92						12.24
17	13.13		0.45	0.60	0.74	1.02					13.13
19	13.61			0.92	1.00						12.68
21	19.89			0.63	0.74	1.21	0.77	0.61			15.65
22	19.23				0.89						15.11
Means			0.63	0.75	0.87	1.21	0.94	0.63			
Departures			−0.02	−0.01	−0.02	+0.03	−0.04	−0.14			

TABLE 1.—*Solar radiation intensities during July, 1926*—Continued

MADISON, WIS.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass A. M.					Air mass P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	1.0[1]	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
July 6	7.29				1.04						14.60
7	14.60				0.99	1.26					12.68
13	8.81				1.22						6.76
14	8.48					1.42					9.83
20	13.13					1.19	0.84				16.20
21	14.60				0.76	1.09					16.20
23	10.97				1.01	1.29					11.38
26	10.59				0.86	1.18					7.29
Means					0.98	1.24	(0.84)				
Departures					−0.07	−0.03	−0.16				

LINCOLN, NEBR.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
July 11	9.83		0.82	0.95	1.27	1.55	1.08	0.85	0.75		10.59
13	7.87				1.17	1.40	1.06	0.97	0.84		7.04
18	13.13				1.04						13.61
19	15.11		0.78	0.91	1.09	1.30			0.63		14.60
20	14.10			0.94	1.12	1.31	0.96	0.77	0.61		11.38
22	12.24			0.85	1.05	1.30	0.99	0.76	0.62		7.29
23	10.50			0.74	0.87						13.61
Means			(0.80)	0.88	1.09	1.37	1.02	0.84	0.69		
Departures			±0.00	−0.01	+0.01	+0.04	−0.04	−0.04	−0.04		

[1] Extrapolated.

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation: Washington	Madison	Lincoln	Chicago	New York	Average daily departure from normal: Washington	Madison	Lincoln
1926	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
July 2	384	509	475	414	368	−97	−28	−102
9	538	585	614	405	357	+57	+55	+31
16	439	530	630	420	440	−36	+18	+59
23	419	426	503	413	380	−45	−64	−42
Excess since first of year on July 29						+847	+3,388	+378

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

Considering the ocean as a whole, the number of days on which winds of gale force occurred was considerably below the normal as shown on the Pilot Chart for July. An unusually severe tropical disturbance, which is described elsewhere in the REVIEW, prevailed during the latter part of the month. Storms of extra-tropical origin, however, were rare, and over the steamer lanes gales were not reported on more than one day in any 5° square.

Fog was again unusually prevalent, and in the region between the 40th and 45th parallels, west of the 50th meridian, it was reported on from 14 to 25 days. The number of days on which it was observed was also above the normal over the eastern section of the steamer lanes, and off the European coast.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, 8 a. m. (75th meridian time), North Atlantic Ocean, July, 1926*

Station	Average pressure	Departure[1]	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	[2] 29.56	(3)	30.00	2d [4]	29.06	27th.
St. Johns, Newfoundland	29.84	−0.14	30.18	30th	29.46	9th.
Nantucket	29.98	0.00	30.24	26th [4]	29.62	7th.
Hatteras	30.00	−0.02	30.24	17th	29.78	11th.
Key West	29.99	−0.02	30.12	20th	29.80	27th.
Swan Island	29.88	−0.04	29.99	29th	29.80	30th.
New Orleans	29.98	−0.02	30.14	21st [4]	29.84	31st.
Turks Island	30.05	+0.04	30.16	20th [4]	29.88	25th.
Bermuda	30.20	+0.09	30.30	17th [4]	30.06	8th.
Horta, Azores	30.25	−0.02	30.44	20th	29.90	12th.[4]
Lerwick, Shetland Islands	29.98	+0.20	30.44	3d	29.45	21st.[4]
Valencia, Ireland	30.06	+0.08	30.48	27th	29.76	18th.
London	30.03	+0.05	30.38	31st	29.68	19th.

[1] From normals shown on H. O. Pilot Chart, based on observations at Greenwich mean noon, or 7 a. m., 75th meridian.
[2] Mean of 23 observations; eight days missing.
[3] No normal established.
[4] And on other dates.

From the 1st to 5th an area of low pressure covered the greater part of Newfoundland, accompanied by light to moderate winds until the 4th, while on the 5th moderate southwesterly gales prevailed in the southeasterly quadrant. This LOW moved rapidly eastward, increasing in intensity, and on the 6th was central near 47° N., 37° W., and westerly winds, force 11, were reported by vessels between the 40th and 45th parallels, and the 35th and 40th meridians. It moved but little during the next 48 hours, and gradually filled in, although on the 7th and 8th moderate gales still prevailed near the center.

On the 9th St. Johns, Newfoundland, was near the center of a LOW that moved steadily eastward, and on the 15th was apparently in the vicinity of Iceland, although it was impossible to plot its track accurately, due to lack of observations. On the 11th moderate gales were reported by vessels near 40° N., 55° W., and also near 45° N., 35° W.

From the 14th to 22d favorable weather was the rule over the entire ocean, and no report of gales occurring during this period has been received, although from the 16th to 22d there was an area of low pressure near the south coast of Iceland, and from the 20th to 22d a slight depression in the vicinity of Newfoundland and Labrador.

From the 19th to 23d the North Atlantic HIGH was unusually well developed, with a maximum barometer reading of 30.44 inches at Horta, on the 20th.

Charts VIII-XI cover the period from the 25th to 28th, inclusive, and give an idea of the intensity and track of the tropical disturbance described elsewhere.

On the 25th there was a depression over the North Sea, where northwesterly gales prevailed. On the 26th a LOW central near 53° N., 40° W., was accompanied by moderate southerly gales in the easterly quadrants.

On the 31st a disturbance was central near 47° N., 25° W., with steep pressure gradients extending eastward and southward, while moderate gales prevailed over a limited area near the center.

The American steamship *Thomas H. Wheeler*, Capt. F. S. McKenzie, from Sabine Pass toward Cape Henry, encountered a waterspout, as shown by the following note furnished by Mr. C. Dwyer, second officer:

Waterspout, July 31. Lat. 24° 55′ N., Long. 83° 54′ W., at 3 p. m. passed waterspout extending down from only Cu.-Nb. cloud in sight. The water immediately below 'spout was violently agitated in a circular movement clockwise, and for a radius of about 400 yards the water ruffled by the wind in a large circle. The 'spout was of a light gray color and swayed and pulsated like a hose under pressure, not reaching the surface, but lengthened and shortened three times before dissipating twenty minutes later in a heavy rain squall. The sea was smooth, with no wind, bar. 30.02, temp. air, 88°, water 84°. The waterspout was stationary, and on the outskirts of the wind area rain was falling in large drops.

OCEAN GALES AND STORMS JULY, 1926

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
			° ′	° ′				Inches					
NORTH ATLANTIC OCEAN													
Cameronia, Br. S. S.	Glasgow	New York	51 49 N.	38 42 W.	6th	8 p., 6th	7th	29.05	E	S., 8	NW	NW., 8	SE.-NE.-NW.
Dront, Br. S. S.	Hamburg	do	46 22 N.	32 51 W.	10th	2 a., 11th	11th	29.65	SW	SW., —	NNW	—, 8	SW.-W.-NNW.
Marija Petrinovic, Jug. Slav. S. S.	Norfolk	Europe	39 45 N.	53 59 W.	11th	1 p., 11th	11th	29.85	SW	SW., 8	SW	SW., 8	Steady.
Mayaro, Br. S. S.	Grenada	New York	17 22 N.	63 56 W.	23d	1 a., 23d	23d	29.66	ENE	ENE., 11	ESE	SE., 12	ENE.-E.-ESE.
Tegucigalpa, Hond. S. S.	Baracoa	do	24 30 N.	73 24 W.	24th	3 p., 25th	25th	29.72	ENE	ENE., 10	E	E., 12	ENE.-E.
United States, Dan. S. S.	Oslo	do	58 32 N.	3 40 E.	25th	9 a., 25th	25th	29.27	S	NNW., 6	NNW	NNW., 8	S.-NW.
William Campion, Am. S. S.	Colon	Philadelphia	23 40 N.	70 00 W.	24th	Noon, 25th	26th	29.52	NE	E., 12	SE	E., 12	NE.-E.-SE.
Bogota, Am. S. S.	New York	West Indies	25 00 N.	74 12 W.	25th	2 a., 26th	26th	29.79	E	E., 10	SE	E., 10	SE.-E.
Ariano, Br. S. S.	London	Montreal	53 25 N.	42 10 W.	26th	4 p., 26th	27th	29.52	WSW	WSW., 7	SSW	WSW., 8	Steady.
Sun, Am. S. S.	Off Miami		25 18 N.	80 05 W.	26th	4 p., 27th	27th	29.57	NNE	WNW., —	WSW	—, 10	NNE.-NW.-W.
Gulfking, Am. S. S.	Philadelphia	Port Arthur	29 10 N.	80 24 W.	27th	Noon, 27th	28th	29.91	ENE	ENE., 6	S	NE., 12	E.-SE.
Orizaba, Am. S. S.	New York	Habana	28 25 N.	79 35 W.	26th	Noon, 27th	28th	29.00	E	NE., 12	SE	NE., 12	N.-NE.
Gulftrade, Am. S. S.	Bayonne	Port Arthur	28 20 N.	78 49 W.	27th	7 p., 27th	28th	29.60	E	E., 10	S	ENE., 11	E.-ESE.
E. R. Kemp, Am. S. S.	Portsmouth	Houston	31 43 N.	31 43 W.	28th	3 a., 28th	29th	29.95	SSE	SSE., —	S	—, 8	SE.-S.
Endicott, Am. S. S.	Galveston	Havre	45 32 N.	23 38 W.	30th	10 p., 30th	31st	29.92	SSW	—, 7	WSW	S., 8	S.-WSW.
Pres. Roosevelt, Am. S. S.	Bremerhaven	New York	50 08 N.	21 10 W.	31st	2 p., 31st	31st	29.87	S	S., 5	W	N., 8	S.-SW.
NORTH PACIFIC OCEAN													
Coalinga, Am. S. S.	Iquique	Los Angeles	17 10 N.	104 00 W.	5th	8 p., 8th	9th	28.90	W	SE., 12	SE	SE., 12	Steady.
F. J. Luckenbach, Am. S. S.	San Pedro	New York	18 00 N.	103 38 W.	7th	6 p., 7th	8th		E	SE., 4	SE	ENE., 9	
Mayebashi Maru, Jap. S. S.	Balboa	Los Angeles	17 36 N.	102 59 W.	8th	9 p., 8th	9th	29.73	ESE	E., —	SE	E., 8	E.-ESE.
Pacific Shipper, Br. S. S.	San Pedro	Panama	18 35 N.	104 22 W.	8th	8 p., 8th	9th	29.67	S	ENE., 9	ESE	ENE., 9	Steady.
Montana, Fr. S. S.	do	Balboa	19 20 N.	105 32 W.	8th	8 a., 9th	9th	29.80	SE	E., 8	SE	E., 8	
Montgomery City, Am. S. S.	Portland, Oreg.	Baltimore	19 12 N.	105 45 W.	9th	9 a., —	9th	29.77	SE	ESE., 7	ESE	E., 8	E.-ESE.
William Campion, Am. S. S.	Grays Harbor.	Balboa	20 13 N.	106 40 W.	8th	4 p., 8th	10th	29.63	W	SE., 8	SE	SE., 8	S.-SE.
Toco, Br. S. S.	San Pedro	Tocopilla	19 10 N.	107 10 W.	9th	3 p., 9th	10th	29.52	E	E., 8	SE	E., 8	
Harold Dollar, Br. S. S.	San Francisco.	Kobe	34 35 N.	139 30 E.	13th	7 p., 14th	14th	29.28	NE		NW	NE., 9	
Weirbank, Br. S. S.	Chemulpo	Shanghai	37 10 N.	126 20 E.	15th	8 a., 15th	16th	29.68	S	S., 8	SSW	S., 10	
Oak Park, Am. S. S.	Honolulu	Balboa	19 15 N.	127 52 W.	18th	1 a., 19th	19th	29.50	N	N., 8	SE	N., 8	N.-S.-SE.
Grace Dollar, Am. S. S.	Karatsu	San Francisco.	48 30 N.	163 47 E.	20th	8 p., 20th	22d	29.93	SSW	SSW., 6	S	SSW., 8	S.-SSW.
Africa Maru, Jap. S. S.	Victoria	Yokohama	52 29 N.	164 16 W.	21st	4 p., 21st	22d		WNW	WNW., 8	WNW	WNW., 8	Steady.
Do	do	do	50 04 N.	175 00 E.	25th	8 a., —	25th		S	SW., 8	SW	SW., 8	S.-SW.
Pres. Taft, Am. S. S.	Honolulu	do	34 49 N.	154 30 E.	26th	2 p., 26th	27th	29.29	SE	SSW., 3	SW	SE., 8	
SOUTH PACIFIC OCEAN													
Canad. Britisher, Br. S. S.	Port Kembla	Panama	34 50 S.	168 00 W.	10th	Midt, 11th	11th	29.32	ENE	NNE 9	NNE	ENE., 10	2 points.

NORTH PACIFIC OCEAN

By WILLIS EDWIN HURD

The Aleutian LOW in June had almost disappeared, except for a great shallow trough over the northern waters of the ocean. At this season the LOW is somewhat vestigial and usually recedes toward the western part of Bering Sea. Recession is also normal to July, but in July, 1926, unusual pressure conditions prevailed in this region. The average barometer at Kodiak was 29.78 inches, 0.18 inch below the normal. At Juneau it was also much below, while at St. Paul, in the eastern Bering Sea, it was almost as decidedly above. Hence a pronounced and abnormal LOW appeared central over the northwestern part of the Gulf of Alaska.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean, July, 1926*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	Inch	Inches		Inches	
Dutch Harbor [1] [4]	29.97	−0.05	30.26	19th	29.54	2d.[5]
St. Paul [1] [4]	29.98	+.13	30.28	19th	29.52	25th.
Kodiak [1] [4]	29.78	−.18	30.16	15th	29.20	3d.
Midway Island [1]	30.10	+.02	30.22	5th [5]	29.94	16th.
Honolulu [3]	30.01	−.01	30.10	29th	29.88	22d.
Juneau	29.91	−.14	30.15	20th	29.49	24th.
Tatoosh Island [2] [3]	30.06	−.01	30.29	31st	29.80	9th.
San Francisco [2] [3]	29.91	−.04	30.06	12th	29.65	8th.
San Diego [2] [3]	29.89	.00	30.02	29th	29.72	9th.

[1] P. m. observations only.
[2] A. m. and p. m. observations.
[3] Corrected to 24-hour mean.
[4] Thirty days.
[5] And on other dates.

The east Pacific anticyclone was permanent throughout the month. Early in July it was central near the American coast, but after the first few days it spread westward and thereafter occupied an enormous area in middle latitudes, being central somewhat east of the 180th meridian.

At Honolulu after the slight break of June in the long drouth the dry conditions returned. The total July rainfall amounted to only 0.36 inch, which was 0.83 inch below the normal. The trades blew 95 per cent of the time, prevailingly from the east, highest velocity 28 miles from the east on the 20th. The temperatures also continued high, and the month was the warmest July since 1900.

Dry weather continued along the American coast south of Vancouver. San Francisco at the end of the month reported the 85th successive day without appreciable rainfall, while Eureka experienced the driest spring and summer on record. Temperatures continued abnormally high. At Juneau, owing to the favorable location of the Aleutian LOW, precipitation occurred frequently.

Very little rough weather occurred over the main body of the ocean, and such gales as were experienced by vessels in mid-sea at various times were only of moderate force.

In the tropics, however, the weather was more disturbed. An account of the typhoons of the Far East during the month is appended.

In the American tropics a small cyclone was encountered on the 21st, near 19° N., 131° W., by the American steamer *Oak Park*. The lowest pressure observed by the vessel was 29.49 inches, highest wind-force, 8. Nothing further is known of the movements of the cyclone.

A full-fledged hurricane raged up the Mexican west coast from the 5th until the 9th. It probably originated near 10° N., 97° W., moved northwestward, and was last heard from near 19° N., 110° W. Several vessels met this storm, but most of them encountered moderate gales and depressions only. Two steamers, the British M. S. *Reginolite*, Capt. F. A. Germain, master and observer, from San Pedro to Balboa, and the American tank steamer *Coalinga*, Capt. N. E. Larson, Mr. S. Lindholm, second officer, Iquique to Los Angeles, experienced heavier winds and seas, and the *Coalinga* battled for hours in a full hurricane, lowest observed pressure 28.90 inches, at 8 p. m. of the 8th, near 17° N., 104° W. This vessel met with strong westerly winds as early as the 3d, when in 6° 26′ N., 94° 33′ W. These continued during the 5th, increasing at times to force 7. On the 6th, in 13° 42′ N., 102° 07′ W., the wind-force rose to 10, the direction changing from SW. and NW. to NE., and barometer down to 29.56. On the 7th the storm became more violent, the winds at times rising to force 12, with blinding rain. From then until 8 a. m. of the 9th hurricane winds predominated. Quoting from the observer:

Due to numerous changes in the direction and force of the wind, the storm appeared to be of a somewhat freaky nature. We judged it to be moving in a NW. direction at a lower speed than the ship. We had apparently reached the center of the storm on the evening of July 8, when the ship was hove to on an SE. course. The *Coalinga* was in ballast and in good trim, and sustained no serious damage, except to bridge, lifeboats, and gear. It may be of interest to note that during two days before the storm reached its greatest force a number of sea birds in exhausted condition took shelter on board the ship.

The following is quoted from the report of Captain Germain, of the ***Reginolite:***

The storm broke at 10 a. m., July 8, the ship than being in lat. 18° 35′ N., long. 104° 20′ W., and continued with increasing violence until midnight, gradually decreasing during the morning of the 9th and dying away at noon.

During the forenoon of the 8th weather reports were exchanged between all vessels in radio communication, and from the information thus secured, the center of the storm was roughly estimated, at noon, to be located in lat. 16° 30′ N., long. 104° W., and to be traveling in a WNW'ly direction. This position is only approximate, however, as barometric readings could be obtained only on one side of the disturbance. It would be interesting to know how this estimate compares with the actual position.

It will be noted that no meteorological information was exchanged between ships until the storm had actually broken. If the ships concerned had done this earlier, much more general information might have been available.

It would be to the general advantage of all vessels trading on eastern Pacific Ocean routes, if daily exchanges of weather reports could be instituted. Valuable information of probable weather changes would be at the mariners' disposal, and warnings of approaching cyclonic disturbances would be available in sufficient time for definite steps to be taken to avoid the storm center.

Along the western two-thirds of the northern steamer routes fog was frequent, particularly south of the westernmost part of the Aleutian chain, where it occurred on about 60 per cent of the days. Between west longitudes 130° and 150° the phenomenon was little observed, but along the American coast from Vancouver to San Diego it was reported as occurring frequently. On the 22d and 23d fog was observed in a somewhat out-of-the-way place for its occurrence, namely, in 19° N., 125° to 130° W.

TYPHOONS AND DEPRESSIONS

FOUR TYPHOONS IN THE PHILIPPINES IN JULY, 1926

By Rev. José Coronas, S. J.

[Weather Bureau, Manila, P. I.]

There were four typhoons in the Philippines during the last month of July, one having passed between Luzon and the Visayas, another across northern Luzon, and the other two across the Balintang Channel.

The first one was an intense but very small typhoon, with a radius of no more than 30 miles. It entered Samar during the night of the 3d to the 4th; traversed Masbate in the morning of the same day, and Romblon in the afternoon. It caused considerable damage but only in a very limited number of towns near the center. The lowest barometric reading recorded in our stations was that of Calbayog 746.03 mm. (29.37 inches) at 6 a. m. of July 4.

The second typhoon was shown by our weather maps on July 13 over the Pacific about 200 miles to the east of Samar. It moved first NW. by W., and then WNW. while crossing northern Luzon in the evening and night of the 15th. Although it was a well developed typhoon while passing northeast of Catanduanes on the 14th, it traversed Luzon in the form of only a shallow depression of little importance. It caused considerable damage in in the provinces of southeastern Luzon by heavy rains and consequent floods. The depression or typhoon inclined to the north in the China Sea passing practically over Pratas in the morning of the 17th. From Pratas to the China coast it moved almost to the north.

On the 19th, when the center was already over China north of Hongkong, a disastrous electric and rain storm took place in the English colony, almost unprecedented in the history of south China. It was reported by the United Press that 20 inches of rain had fallen in seven hours, many buildings having been wrecked and several lives lost.

The third typhoon was probably formed on the 17th to 18th over the Pacific 500 or 600 miles east of northern Luzon. It seems to have moved almost due west until the afternoon of the 19th when the center was about 200 miles east of northern Luzon. Then it moved NNW., but only for less than one day. After 10 a. m. of the 20th the typhoon took a WNW. direction and traversed the Balintang Channel about half way between Aparri and Basco during the night of the 19th to 20th. The center passed close to the south of Hongkong in the morning of the 22d.

The barometric minima recorded in Aparri and Basco were 747.87 mm. (29.44 inches) and 747.97 mm. (29.45 inches), respectively.

The last typhoon of the month was so small that it hardly influenced the weather of the Philippines, except in the Batanes Islands and the northernmost part of Luzon. It was probably formed about 150 miles east of northern Luzon on the 29th, and took a NW. and NNW. direction passing through the eastern part of Balintang Channel in the morning of the 30th and very close to the Batanes Islands at about 6 or 7 p. m. of the same day. The center was over Formosa in the afternoon of 31st. The lowest barometric minimum recorded in Basco, Batanes Islands, was 750.76 mm. (29.56 inches).

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The two outstanding features of the month were the extraordinary hot spell that culminated on the 21st–22d in northeastern districts and the West Indian hurricane that passed inland over Florida and the East Gulf States on the closing days of the month.

High temperatures in northeastern districts were the result of what appears to have been a purely fortuitous pressure distribution at the time. The ordinary succession of anticyclone and cyclone is anticyclone-cyclone-anticyclone, etc., etc. In this particular case the succession was different, viz, anticyclone-cyclone-cyclone-anticyclone.

The wind-systems associated with these barometric formations as they move eastward along the border between Canada and the United States, as is well known, induce successively an indraught of warm air from the south in cyclones and cool air from the north in anticyclones; when, however, as in July 1926, a cyclonic wind system is immediately followed by a second cyclonic system there can be but one result, viz, an intensification of the temperature, and this is precisely what happened on the days in question.

The anticyclone which dissipitated the heat wave arrived over the North Atlantic so timed as to prevent the West Indian hurricane from recurving to the northeast when the latter was off the east Florida coast and it was therefore forced to pass inland and soon to lose its tropical characteristics.

The usual details of the weather of the month follow and these are further illumined by the series of Charts Nos. I–VI.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

The tracks of 15 low-pressure and 8 high-pressure areas were charted for the month of July. The feature of the month, however, was the West Indian hurricane of the 22d to 31st, which has been treated elsewhere in this REVIEW. There were no other storms of more than slight intensity and the HIGHS were generally inactive.

FREE-AIR SUMMARY

By L. T. SAMUELS

The mean free-air temperatures for the month averaged close to their normal values, there being a rather marked tendency, however, for increasing positive departures to obtain at the upper levels at all aerological stations except Ellendale. The same was generally true for the vapor pressure, while the relative humidity departures were small and mostly of opposite sign to those for temperature. (Table 1.)

The most striking feature in Table 2 is the marked contrast between the resultant winds up to the 2,500 m. level at Ellendale and their normal directions for these levels. The unusually large number of days with deep easterly winds at this northern station made it impossible for the kites to attain their usual maximum altitudes.

It is of interest to note the prevalence of easterly winds reaching to the cirrus level and occasionally higher over the southeastern part of the country from the 18th to 22d, during which time exceedingly high surface temperatures occurred throughout the region. During this period the Bermuda HIGH extended its influence over this area and pilot-balloon observations showed that the southerly winds in its rear sector did not veer with altitude and become westerly, but backed and shifted to easterly. One of the most interesting observations made during this period was the double theodolite observation on the 19th at Broken Arrow to a height of 14 km.; easterly winds of moderate velocity were found to prevail to this level.

What is believed to be a record altitude for a two-theodolite observation was made at Broken Arrow on the 3d. The balloon was followed with both theodolites for 122 minutes and a practically uniform rate of ascent (about 190 m. p. m.) continued during the first 100 minutes, at the end of which the height was 19km. During the last 22 minutes, however, the rate of ascent decreased considerably (averaging only about 90 m. p. m.) and the greatest height reached was 21 km. Easterly winds of 12 m. p. s. prevailed at this altitude. The balloon was finally eclipsed by Ci. Cu. clouds. It was the very light winds, of course, which made it possible to follow the balloon for so long a time and to such a great height.

On the morning of the 29th Due West was situated in the northern sector of a tropical hurricane. Notwithstanding decidedly unfavorable conditions for a kite flight, owing to light rain, low clouds, and a rapid increase in wind velocity off the ground, a flight was started and 1,365 m. altitude above ground attained. The record revealed a deep cloud layer with its base only a few hundred meters above ground and extending *higher* than the maximum altitude reached by the kites. On the previous day (28th), i. e., before the tropical storm had reached Due West, the top of this cloud layer was found to be only 800 m. above ground. An examination of these records shows that while the free-air temperatures rose from the 28th to the 29th throughout an 800 m., air column, i. e., to the upper limit of the cloud layer on the 28th, above this level the temperatures were *lower* on the 29th than on the 28th. Of special interest is the fact that throughout this higher air column wherein condensation had occurred (as indicated by the increased thickness of the cloud layer by the 29th) an actual decrease in temperature from the previous day occurred despite the latent heat of condensation thus necessarily liberated. It is therefore rather strikingly shown that a pronounced lowering of the temperatures at elevations above 800 m. occurred with the arrival of the northern sector of this tropical disturbance. The observed temperatures on these days are shown in the following table:

Altitude (m.) m. s. l.	Temperature (° C.)		Altitude (m.) m. s. l.	Temperature (° C.)	
	28th	29th		28th	29th
217 (surface)	22.2	23.4	1,000	17.5	18.3
250	22.0	23.1	1,250	17.8	17.3
500	20.5	21.0	1,500	16.7	15.7
750	19.0	19.2	2,000	13.9	[1] 12.0

[1] Extrapolated.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during July, 1926*

TEMPERATURE (° C.)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		*Washington, D. C. (7 meters)
	Mean	Departure from 8-year mean	Mean	Departure from 6-year mean	Mean	Departure from 9-year mean	Mean	Departure from 8-year mean	Mean	Departure from 9-year mean	Mean
Surface	25.2	−1.5	27.8	+0.4	22.1	+0.8	26.4	−0.4	24.2	−0.8	23.2
250	25.0	−1.6	27.5	+0.5			25.7	−0.2	23.9	−0.8	21.5
500	23.6	−1.4	25.2	+0.7	21.6	+0.7	24.1	+0.1	21.7	−0.5	20.5
750	22.2	−1.4	23.1	+0.5	20.2	+0.6	22.7	−0.1	20.7	+0.3	19.3
1,000	20.8	−1.4	21.5	+0.6	18.9	+0.5	21.3	−0.4	18.9	+0.3	18.1
1,250	19.5	−1.1	19.9	+0.8	17.6	+0.3	20.0	−0.5	17.2	+0.3	16.7
1,500	18.7	−0.4	18.3	+0.9	16.1	0.0	18.9	−0.2	16.0	+0.6	15.4
2,000	16.7	+0.7	14.7	+0.6	13.2	−0.2	16.4	0.0	12.9	+0.3	12.9
2,500	13.8	+1.0	12.2	+1.2	10.4	0.0	13.5	−0.1	10.4	+0.5	10.5
3,000	10.7	+1.1	10.3	+2.4	7.6	+0.1	11.2	+0.4	7.8	+0.8	7.7
3,500	7.7	+1.0	7.0	+2.3	4.6	0.0	8.2	+0.4	4.8	+0.7	4.5
4,000	5.1	+1.5	3.8	+2.0	1.7	−0.2	6.2	+1.5	1.9	+0.6	1.5
4,500	3.5	+2.3	0.8	+1.8	−1.7	−1.1			−1.1	+0.3	−1.3
5,000					−4.3	−1.0					

RELATIVE HUMIDITY (%)

Altitude, m. s. l. (meters)	Broken Arrow, Mean	Departure	Due West, Mean	Departure	Ellendale, Mean	Departure	Groesbeck, Mean	Departure	Royal Center, Mean	Departure	*Washington, Mean
Surface	60	0	60	−4	62	−6	77	+4	60	−2	78
250	60	0	60	−4			77	+3	60	−2	80
500	65	−1	62	−4	62	−5	77	+2	61	−3	74
750	64	−1	65	−3	61	−2	75	+4	61	−5	73
1,000	64	−1	68	−2	62	+1	76	+10	65	−3	67
1,250	61	−4	68	−3	59	0	75	+12	66	−2	67
1,500	55	−9	72	+1	59	+2	70	+8	63	−4	67
2,000	48	−14	72	+1	61	+6	65	+5	61	−2	68
2,500	47	−14	63	−7	56	+3	64	+5	55	−1	67
3,000	48	−13	58	−10	54	+4	59	+1	47	−5	68
3,500	50	−11	61	−4	56	+6	59	0	49	−1	67
4,000	53	−8	63	0	60	+9	83	+20	50	+3	61
4,500	50	−5	65	+8	63	+11			52	+5	43
5,000					47	+1					

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during July, 1926*—Continued

VAPOR PRESSURE (*mb.*)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		*Washington, D. C. (7 meters)
	Mean	Departure from 8-year mean	Mean	Departure from 6-year mean	Mean	Departure from 9-year mean	Mean	Departure from 8-year mean	Mean	Departure from 9-year mean	Mean
Surface	22.04	−1.76	21.58	−0.93	16.04	−1.07	26.28	+0.80	18.10	−1.46	22.39
250	21.82	−1.78	21.30	−0.83			25.14	+0.59	17.88	−1.40	20.56
500	19.21	−1.49	19.25	−0.55	15.52	−1.01	22.75	+0.54	16.22	−0.88	17.72
750	17.42	−1.18	17.86	−0.44	13.81	−0.51	20.48	+1.04	15.14	−0.49	16.08
1,000	15.94	−1.01	16.73	−0.23	12.82	+0.02	19.06	+2.11	14.29	−0.11	13.85
1,250	14.04	−1.40	15.31	−0.29	11.27	−0.16	17.27	+2.26	13.25	+0.20	12.69
1,500	12.00	−1.91	14.47	+0.36	10.28	+0.06	14.72	+1.18	11.81	+0.16	11.67
2,000	9.12	−2.03	11.56	+0.06	8.85	+0.57	11.82	+0.61	9.24	+0.34	9.91
2,500	7.44	−1.52	8.42	−0.74	7.18	+0.44	9.75	+0.48	6.73	+0.23	8.25
3,000	6.40	−0.84	6.97	−0.31	6.11	+0.68	7.87	+0.09	4.88	−0.13	6.82
3,500	5.56	−0.37	6.08	+0.49	5.43	+0.88	6.53	−0.05	4.24	+0.16	5.42
4,000	5.05	+0.29	5.54	+1.05	4.96	+1.14	8.32	+2.43	4.08	+0.82	4.04
4,500	4.30	+0.67	4.98	+1.43	3.98	+0.61			4.04	+1.15	2.67
5,000					2.27	−0.42					

* Naval Air Station.

TABLE 2.—*Free-air resultant winds (m. p. s.) during July, 1926*

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)			
	Mean		8-year mean		Mean		6-year mean		Mean		9-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 16°W.	2.5	S.	3.0	S. 31°E.	0.7	S. 61°W.	1.0	N. 42°E.	1.8	N. 26°E.	0.2
250	S. 15°W.	2.6	S.	3.1	S. 24°E.	0.7	S. 63°W.	1.1				
500	S. 11°W.	4.8	S. 12°W.	4.6	S. 65°E.	0.9	S. 74°W.	1.5	N. 54°E.	1.8	S. 76°E.	0.1
750	S. 20°W.	5.0	S. 20°W.	5.0	S. 62°E.	1.1	S. 83°W.	1.7	N. 55°E.	1.9	S. 14°W.	0.8
1,000	S. 21°W.	4.6	S. 28°W.	4.9	S. 76°E.	1.2	W.	2.0	N. 62°E.	1.6	S. 45°W.	1.3
1,250	S. 28°W.	3.9	S. 32°W.	4.6	N. 57°E.	1.2	S. 88°W.	2.3	N. 52°E.	1.5	S. 62°W.	1.7
1,500	S. 36°W.	3.7	S. 38°W.	4.5	N. 73°E.	0.8	S. 88°W.	3.2	N. 67°E.	1.0	S. 73°W.	2.4
2,000	S. 41°W.	4.1	S. 41°W.	3.7	N. 42°W.	3.8	N. 85°W.	5.0	N. 9°W.	0.9	S. 88°W.	3.7
2,500	S. 63°W.	4.4	S. 54°W.	3.9	N. 53°W.	5.6	N. 82°W.	6.1	N. 71°W.	1.8	N. 83°W.	5.6
3,000	S. 66°W.	4.6	S. 63°W.	4.4	N. 49°W.	7.6	N. 88°W.	7.6	N. 74°W.	6.2	N. 82°W.	7.4
3,500	N. 76°W.	4.7	S. 82°W.	4.8	N. 67°W.	9.6	N. 81°W.	7.8	N. 72°W.	14.1	N. 74°W.	10.3
4,000	N. 65°W.	4.5	S. 79°W.	6.1	N. 78°W.	10.4	N. 81°W.	8.7	N. 72°W.	15.9	N. 69°W.	11.8
4,500	N. 53°W.	10.4	S. 83°W.	8.1	N. 78°W.	10.8	N. 84°W.	9.5	S. 78°W.	17.0	N. 70°W.	13.3
5,000									S. 67°W.	26.2	N. 79°W.	15.9

Altitude m. s. l. (meters)	Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)	
	Mean		8-year mean		Mean		9-year mean		Mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 3°E.	3.8	S. 19°W.	3.6	S. 43° E.	0.6	S. 78°W.	1.4	N. 26°W.	0.4
250	S. 5°E.	4.5	S. 21°W.	4.5	S. 22° E.	1.0	S. 75°W.	1.6	N. 24°W.	1.0
500	S. 8°W.	5.9	S. 29°W.	6.0	S. 22°W.	2.4	S. 70°W.	3.0	N. 42°W.	2.7
750	S. 9°W.	6.3	S. 28°W.	6.2	S. 39°W.	2.6	S. 72°W.	3.9	N. 43°W.	4.1
1,000	S. 15°W.	6.1	S. 30°W.	5.9	S. 78°W.	3.0	S. 80°W.	4.5	N. 46°W.	4.5
1,250	S. 13°W.	5.9	S. 30°W.	5.5	S. 87°W.	4.5	S. 83°W.	5.4		
1,500	S. 17°W.	5.3	S. 29°W.	4.9	N. 83°W.	6.0	S. 87°W.	6.1	N. 62°W.	4.5
2,000	S. 18°W.	5.5	S. 30°W.	4.0	N. 86°W.	7.8	S. 89°W.	7.3	N. 72°W.	4.9
2,500	S. 22°W.	6.6	S. 25°W.	3.9	S. 88°W.	11.3	N. 88°W.	9.8	N. 66°W.	6.6
3,000	S. 27°W.	5.0	S. 23°W.	3.8	N. 88°W.	12.9	W.	11.4	N. 76°W.	5.6
3,500	S. 24°W.	4.0	S. 16°W.	2.5	S. 87°W.	12.6	S. 87°W.	11.2	N. 87°W.	7.2
4,000	S. 68°W.	11.1	S. 86°W.	1.6	N. 58°W.	15.3	N. 68°W.	10.4	S. 79°W.	8.1
4,500	S. 68°W.	11.1	N. 12°W.	2.4	N. 45°W.	14.0	N. 46°W.	9.5	S. 83°W.	9.0
5,000									S. 88°W.	9.3

THE WEATHER ELEMENTS

By P. C. DAY, in Charge of Division

PRESSURE AND WINDS

As is usual in summer there was little important atmospheric activity save from about the 7th to 10th when a cyclone moved from western Canada through the Dakotas, upper Mississippi Valley, Great Lakes region, and to the St. Lawrence Valley. This was attended by heavy local rains, severe thunderstorms, hail and high winds over large areas from the middle and northern plains eastward. Pressure during this storm was unusually low for the summer season over large areas in the upper Mississippi Valley and Great Lakes region, some stations reporting the lowest sea-level pressures ever observed in July.

From the 14th to 16th low pressure was general over the Gulf and Atlantic Coast States, but without definite cyclonic features until the latter part of the period, though heavy rains fell over much of the territory.

There was little cyclonic activity during the latter half of the month until toward the end, when a severe tropical storm moved northwestward over the Bahama Islands to the Florida Peninsula, reaching the northeast coast of that State on the morning of the 28th attended by hurricane winds and heavy rains, whence it moved with decreasing intensity over the central portions of

Alabama and to northern Mississippi by the end of the month. A full description of this storm and details as to loss of life and damages to property appear elsewhere in this issue.

Over the Pacific Coast States and in the far Northwest anticyclonic conditions were dominant, and no important cyclones developed during the month.

The sea-level pressure averages were moderately low and less than normal from the Rocky Mountains westward and from the eastern Plains to the Atlantic coast, except over the Northeastern States and Canadian Maritime Provinces. Elsewhere they were slightly above normal, though departures from average in all cases were small. Compared with June the pressure averages were materially higher in all districts of both Canada and the United States save in the Northwest and far West where July averages were in some cases materially lower than in June.

Thunderstorms were generally frequent in the areas where these usually occur, and they were attended by high winds and damaging hail in a number of instances, the more important of which are set forth in the table at the end of this section.

As there were no important variations in the monthly averages of pressure, the winds were not greatly influenced by the pressure gradients; however, they were mainly from southerly points from the Rocky Mountains eastward, though numerous exceptions were noted. West of the Rockies the winds were mainly inward toward the Great Basin.

TEMPERATURE

The outstanding features of the temperature distribution were the continued persistence of hot weather over the far West and Northwest, where for seven consecutive months temperature averages have continued above normal. In a few sections, notably in Idaho, July makes the ninth consecutive month having average temperatures above the normal. On the other hand, temperatures lower than normal have persisted almost as continuously over the northeastern sections, where each of the six months from February to July inclusive has shown a more or less important negative departure. Similar conditions have persisted over many parts of the South during the same period.

During the seven months, January to July, inclusive, 1926, the daily temperatures at Havre, Mont., have averaged slightly more than 7.5° above normal, while for the same period Burlington, Vt., has shown an average daily deficiency of slightly more than 4.5°.

Although the average temperatures showed no marked variations from normal, except in rather small areas, still the month had marked extremes over considerable areas. The highest temperatures ever observed in July or in any month were reported from a number of points in the far Northwest on the 10th, while over portions of Ohio and thence eastward to the Middle Atlantic States the maximum temperatures from the 20th to 22d were in many cases the highest ever observed in July. About the 12th to 14th temperatures were unusually low over portions of the central valleys and Lake region, some sections experiencing temperatures nearly or quite as low as were ever before reported in July.

Considering the temperature by weeks, the first week was generally warmer than normal save about the Great Lakes region and locally in the South. This period was decidedly warm in the plateau regions and over much of the central valleys. The second week was mainly cooler than normal except over some eastern and southern districts, and in the far Northwest, where locally in Washington and Oregon the maximum temperatures on the 10th broke all previous records. The third week was much warmer than normal over the northern plains, Rocky Mountain and plateau regions, and moderately cool in the districts to the eastward, while the week ending the 27th was mainly warm from the Mississippi Valley eastward, particularly at the beginning of the week, when a hot wave of unusual severity prevailed over the central valleys and eastern districts. The last few days of the month were moderately cool and pleasant in practically all parts of the country.

The average temperature was below normal from the Great Lakes eastward, including portions of the Ohio Valley, also over most of the Gulf States and Southwest. It continued materially above normal in the far Northwest, and it was above to a less extent over a considerable area from the Dakotas southeast to the Middle Atlantic coast.

Temperatures above 100° were observed at some time during the month in all the sections save Florida, where 99° was the maximum. The highest reported was 125° in the desert regions of southern California, but readings of 110° or higher were reported locally in Alabama and in many States from the Great Plains westward.

Freezing temperatures were reported at exposed points along the northern border from North Dakota eastward about the 10th to 14th and temperatures considerably below freezing were reported from the mountain districts of the Southwest on the 8th to 10th, while further north similar temperatures occurred on the 20th and 21st. The lowest observed, 25°, was reported from the high mountain regions of eastern Oregon.

PRECIPITATION

The marked feature of the precipitation was the great variation in the total monthly falls as between nearby points, causing exceedingly divergent conditions as to sufficient or insufficient soil moisture.

While many sections had near normal precipitation and a few small areas had excessive falls, much of the country, as has been the case in previous months, had less than the normal. Even where the total fall was near the normal, the distribution during the month often was unsatisfactory and many areas were at some time seriously affected by drought.

Large areas in the central valleys and eastern districts had far less than the usual fall for July, notably in the lower Missouri and middle Mississippi Valleys, in the greater part of Virginia and the Carolinas, and in the far Northwest. On the other hand there were large local excesses in the Southeastern States, due mainly to the heavy rains attending the tropical storm near the end of the month. Texas and Oklahoma had materially more than the usual fall, and it was mainly well distributed over the States and during the month. There were slight excesses near the Middle Atlantic Coast, and locally in the Ohio and upper Mississippi Valleys, where small areas had unusually heavy falls.

In the middle Rocky Mountains and parts of adjacent areas there was usually more than the normal precipitation, and the distribution through the month was usually satisfactory. The far West had little precipitation, where since January 1 it has been scanty in many sections.

As stated elsewhere thunderstorms were locally numerous, particularly in portions of the Ohio Valley and to the eastward. Hail fell in many localities and on many different dates. At Key West, Fla., considerable hail fell on the 15th, a phenomenon not observed there since official weather observations began in 1871, though authentic reports indicate that hail occurred in 1868 or 1869.

On account of the dry conditions, the generally high temperatures and frequent low humidity, many fires occurred in the forests of the Northwest and much damage to timber resulted. There was also a considerable shortage of water for irrigation on a number of western projects, due chiefly to lack of snow last winter and partly to deficient rainfall since.

HUMIDITY

As was the case with precipitation the relative humidity percentages varied greatly, though on the whole they were less than normal from the Great Plains eastward, save in portions of New England, along the South Atlantic Coast, and in Texas, where there were general excesses. Humidity was generally low over the Pacific Coast States and in the far Northwest, some of the lowest percentages ever observed being reported. These low humidities associated with high temperatures and general drought conditions greatly increased the fire hazard.

In the middle Rocky Mountains and nearby areas the percentages were mostly above normal.

SEVERE LOCAL HAIL AND WIND STORMS, JULY, 1926

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau.]

Place	Date	Time	Width of path yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Butler County, Iowa	1	9.20 p. m.	1,760–3,520		$65,000	Hail	Crops damaged and window panes broken over path 5 to 10 miles long.	Official, U. S. Weather Bureau.
Southern Cherry and northern Hooker Counties, Nebr.	1	10.30 p. m.	1,760–3,080		150,000	Hail	Windows broken and crops and roofs badly damaged.	Do.
Santuck (near) S. C.	1			1		Thunderstorm	No property damage reported; one cow killed.	Do.
Columbia (near), Tenn	2				55,000	Hail	Considerable crop injury; minor damage to buildings.	Do.
Blanca (near), Colo	3				1,000	do	Crop damage over small area.	Do.
Upton, Wyo	3				4,000	do	Character of damage not reported	Do.
Philadelphia, Pa., and vicinity.	3–4					Thunderstorm	Several buildings struck by lightning, some damage by flooding.	Do.
Joyner, Ark	4	4.30 p. m.	1,760			Heavy hail	Cotton severly damaged. Path 4 miles long	Do.
Aurora, Mo. (4 miles south of).	4	6 p. m.			600–800	Hail	Crops and orchards damaged	Do.
Memphis, Tenn	4				10,500	Thunderstorm	Grandstand unroofed; electric power and telephone service impaired.	Do.
Mooring, Tenn. (vicinity of).	4				35,000	Hail	Eight hundred acres of crops practically ruined and 600 acres damaged.	Do.
O'Brien and Sioux Counties, Iowa.	4	p. m.	3,960		64,000	do	Crops damaged; path 20 miles	Do.
Tillman (near), Miss	4	p. m				Tornado	Moderate damage to property	Do.
Tulip, Ark	4					Heavy hail	Crops damaged about 30 per cent	Do.
Buffalo Creek, Colo	5	3–4 p. m.	2,600			Hail	Much damage to roads reported	Do.
Chickasha, Okla. (5 miles northeast of).	5	4 p. m.	3,520		12,000	do	Crops damaged, path three and a half miles long	Do.
Staunton, Ill	6	11.20 a. m.	5 mi.		15,000	Wind	Damage chiefly to property; minor crop injury	Do.
Laramie, Wyo	6	1.45–3 p. m				Hail and rain	Streets and basements flooded	Do.
Bourbon County, Ky	6			1	40,000	Wind, rain and electrical.	Extensive damage to crops, buildings and wire systems.	Do.
Campbell, Ky	6				50,000	do	do	Do.
Cloverport (near), Ky	6			3		Electrical	No property damage reported	Do.
Jasper County, Ill. (north-central part of).	6		880			Hail	Corn crop ruined	Do.
Ohio	6					Thunderstorms and wind.	Telephone and telegraph service crippled; traffic impeded; buildings and crops severely damaged. Dayton and Columbus suffer most.	Journal (Dayton, Ohio).
Sangamon County, Ill	6			1		Thunderstorm	One person injured	Official, U. S. Weather Bureau.
New England, N. Dak	7				20,000	Small tornado	A number of buildings wrecked	Evening Post (Chicago, Ill.).
Senatobia (near), Miss	7					Thundersquall	Some property damage reported	Official, U. S. Weather Bureau.
Salina, Dickinson, and Ottawa Counties, Kans.	8	6–8 p. m.	25 mi.		25,000	Hail	Window panes broken, roofs, and autos damaged.	Do.
Dickinson and Morris Counties, Kans.	8	9.30 p. m	165		6,000	Tornado	No towns in path	Do.
Kansas City, Mo	8	9.32 p. m			203,500	Thunderstorm and wind.	Fire started by lightning destroyed roofing plant and elevator.	Do.
Wichita, Kans., and vicinity.	8	11.30 p. m.				Violent wind	Damage chiefly to telephone and power lines and oil rigs.	Do.
Alpena, Mich	8					Thunderstorm	Many trees blown down and small buildings damaged.	Do.
Briggsville, Ark	8	p. m.	3,520			Heavy hail	Crops ruined	Do.
Great Bend (near), Kans	8	p. m.	3,520			Violent wind	Wheat stacks and farm buildings damaged	Do.
Port Huron, Mich	9	2.15 p. m.			1,000	Wind and rain	Scores of shade trees uprooted; several persons injured; minor damage to buildings.	Official, U. S. Weather Bureau; Port Huron Times Herald (Mich.).
Buel Center, Mich	9	2.20 p. m.	1,760		30,000	Tornadic wind	Eight barns and 2 silos blown down; orchards and shade trees leveled.	Do.
Calham, Colo., and vicinity	9	3 p. m.	8,000		20,000	Hail	Poultry killed; windows broken	Official, U. S. Weather Bureau.
Simla, Colo	9	4–5 p. m.	4,000		40,000	do	Crops damaged	Do.
Florence County, Wis	9	4.30 p. m.	10 mi.			do	All crops badly damaged	Do.
Indianapolis, Ind., and vicinity.	9	9.30 p. m.				Thunderstorm and wind.	Trees prostrated; traffic impeded; wires down in some sections.	Official, U. S. Weather Bureau; Star (Indianapolis, Ind.).
Buchanan (near), Mich	9	11 a. m.		3	10,000	Tornado	Several cottages destroyed; four persons injured	Berrien County Journal (Buchanan, Mich.); Official, U. S. Weather Bureau.
Centralia, Ill	9					Wind	Considerable damage reported by newspapers	Official, U. S. Weather Bureau.
Coffeen (near), Ill	9			1		Electrical	Barn destroyed; one person injured	Do.
Erie, Pa	9	p. m.		1		Wind and rain	Large circus tent wrecked injuring 20 people	Do.
Genesee and Monroe Counties, N. Y.	9	p. m.				Severe thunderstorm.	Trees, crops, buildings, and telephone lines damaged.	Do.

[1] "Mi." signifies mile instead of yards.

Severe local hail and wind storms, July, 1926—Continued

Place	Date	Time	Width of path yards	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Hammond, Ind	9		100		5,000	Thunderstorm and wind.	Some property damage	Official, U. S. Weather Bureau.
Ladessa, Okla	9	p. m	1,760		1,000	Hail	Crops damaged	Do.
Michigan City, Ind. (near)	9		16			Probably tornado	A number of barns and small buildings demolished.	Do.
Syracuse, N. Y., and vicinity.	9	p. m		1	500,000	Thunderstorm	Cellars and sewers flooded; embankments and driveways washed out; crops injured; buildings damaged by wind and lightning.	Do.
Blaine County, Okla	10	A. m	3 mi.		250,000	Hail	Roofs and auto tops pierced; windows broken; poultry killed; many fields swept clean.	Do.
South Windsor, Conn	10	5 p. m	166		8,000	Tornado	Tobacco barns on several farms damaged; path 3 miles long.	Hartford Courant (Conn.).
Kenton, Okla., and vicinity.	10	6.20-6.40 p. m.	3,520		45,000	Hail	Two roofs riddled; gardens and some alfalfa fields completely ruined; some poultry killed; path 15 miles.	Official, U. S. Weather Bureau.
Philadelphia, Pa., and vicinity.	10	7.32-9.55 p. m.				Wind and electrical.	Trees leveled; some damage to buildings by lightning; traffic impeded.	Do.
Blanca (near), Colo	10				2,500	Hail	Crops damaged over small area	Do.
Claiborne County, Tenn. (western part of).	10		5 mi.		50,000	....do	Crops and timber damaged over path 10 miles long.	Do.
Howard, southern Baltimore and northern Anne Arundel Counties, Md.	10	P. m				Thundergust	Some trees uprooted and minor property damage.	Do.
Kedron (near), Tenn	10				1,500	Hail	Crops hurt	Do.
Elk Creek (near), Nebr	11	5-8 p. m	4 mi.			....do	Considerable damage in places; path 8 miles long.	Do.
San Jose and Delavan, Ill. (near).	12	3.30-4.30 p. m.	1,760			....do	Crops severely injured in places	Do.
Prairie Home, Nebr	12	3.30-5 p. m.	3 mi.		5,000	....do	Considerable destruction in places	Do.
Bradshaw, Nebr	12	4.20-4.45 p. m.	4 mi.			....do	Windows broken, roofs punctured, crops damaged 80 per cent and gardens totally destroyed.	Do.
Lincoln County, Okla. (northern part of).	12	7 p. m	4,400		20,000	....do	General damage reported. Amount of damage other than that of crops considerable but not estimated.	Do.
Fremont, Louisa, Monroe, and Union Counties, Iowa.	12	P. m			112,500	....do	Damage chiefly to crops; some poultry killed and windows broken.	Do.
Weatherford (near), Tex	12		3 mi.		500,000	Wind and hail	A number of houses and barns demolished; cotton and corn injured. Path 15 miles.	Dallas Morning News (Tex.).
Jeffersonville, N. Y	13		1,320		15,000	Moderate hail	Crops and buildings damaged	Official, U. S. Weather Bureau.
Sterling, Colo	14	4 p. m	3,520		5,000	Hail	Crops damaged	Do.
Biloxi, Miss. (Back Bay Section).	15					Thundersquall	Several frame buildings blown down; some property damaged by lightning, and small craft injured.	Do.
Madrid, Nebr	15		3,520		25,000	Hail	Character of damage not reported. Path 10 miles long.	Do.
Spooner, Wis	16	1.30 a. m	3 mi.		50,000	....do	Damage principally to crops	Do.
Northern Bayfield County to northwest Vilas County, Wis.	16	6.15 p. m	100-440	3	90,000	Tornado and hail	Farm buildings, bridges, overhead wires, timber and crops wrecked or damaged. Path 85 miles long; 16 persons injured.	Do.
Lancaster, Pa., and vicinity.	18	A. m				Electrical and hail	Considerable damage, particularly in Elizabethtown.	Do.
Tioga and Lycoming, Pa	18	1.50 p. m				Severe hail	Crops badly beaten	Do.
Garrett County, Md. (northwest part of).	18	5-6 p. m	4 mi.		100,000	Hail	Birds killed; auto tops pierced; roofs damaged; fields and orchards ruined. Path 15 miles long.	Do.
Preston County, W. Va. (northern part of).	18	5.30-6 p. m.	1,320		200,000	Heavy hail	Great damage to crops, roofs, and windows	Do.
Parkersburg, W. Va	18	P. m				Wind	Many fruit and shade trees ruined; awnings and signs blown down; wires damaged.	Do.
New England (sections of)	18	Do		7		Series of thunderstorms.	Some buildings destroyed, others damaged; telephone and light service crippled in many places; trees uprooted.	Official, U. S. Weather Bureau; Hartford Courant (Conn.); Boston Post.
Mount Gretna and vicinity and York and Adams Counties, Pa.	18	Do				Heavy hail and electrical.	Considerable hail damage; minor damage by wind.	Official, U. S. Weather Bureau.
Van Wert County southeast across State into Monroe County, Ohio.	18	Do		1	455,000	Series of thunderstorms and hail.	Extensive crop damage	Do.
Corning to Horseheads, N. Y.	18		1,760			Heavy hail	Corn, tomatoes, garden truck, and greenhouses damaged.	Do.
Julesburg, Colo	20	5.45-6 p. m.	2,440		30,000	Hail	Chief damage to crops	Do.
Gillette, Wyo. (10 miles northwest of).	20					....do	Crops destroyed	Do.
Dunn, Chippewa, Clark, Taylor, Lincoln, Langlade, Oconto, Marinette, and Door Counties, Wis., to Washington Island.	20-21	10 p. m.-3 a. m.	½-30 mi.		297,000	Severe squall, probably tornado.	Scores of farm buildings wrecked; trees prostrated; crops ruined. Path 240 miles long.	Official, U. S. Weather Bureau; Telegram (Chippewa Falls, Wis.).
Kauhauna, Wis	21	3.15 p. m	880		2,000	Severe squall	Damage chiefly to buildings	Official, U. S. Weather Bureau.
Lynxville, Wis	21	4 p. m	1,760		10,000	Hail	....do	Do.
Dalton, Nebr. (18 miles northwest of).	21	4.15 p. m	16-33			Small tornado	Storm passed over sparsely settled region	Do.
Altus (near), Okla	21	9.30 p. m			50,000	Heavy hail	Heavy crop loss	Do.
Chester, S. C	21				2,400	Thunderstorm	Barns and outbuildings fired by lightning	Do.
Hobart, Okla. (4 miles west of).	22	2 a. m	1,760		20,000	Heavy hail	Damage confined to crops	Do.
Sunbury, Pa	22	5 p. m	10 mi.		100,000	Wind and electrical.	Crops and buildings damaged	Do.
Albany, N. Y	22			3	250,000	Severe thundersquall.	Trees, buildings, and overhead wires damaged	Do.
Maine (Atlantic coast and vicinity).	22				14,100	Wind and hail	Trees uprooted; buildings, wires, autos, and signs damaged.	Do.
Orange, Ind	22					Heavy hail	Considerable damage reported	Do.
South-central counties, N.Y.	22					Thundersqualls	Heavy damage to trees, buildings, and telephone lines.	Do.
Sparta (near), Tenn	22					Wind and hail	Trees uprooted, small buildings partially wrecked, crops injured.	Do.
Plymouth and Sioux Counties, Iowa.	23	3-5 p. m				Hail	Crops damaged 50 per cent	Do.
Romney, W. Va. (2 miles northwest of).	23	3.30 p. m	1,760-3,520		75,000	Heavy hail	Extensive crop and property damage	Do.

Severe local hail and wind storms, July, 1926—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Lyman, Nebr. (4 miles south of).	23	4 p. m.	3,520		6,000	Hail	Damage over small area	Official, U. S. Weather Bureau.
Dalton, Nebr. (west of)	23	5 p. m.	1,760		5,000	do	do	Do.
Gothenburg, Nebr. (north of).	23	5-7 p. m.	2,640		12,000	do	do	Do.
Valley County, Nebr. (eastern part of).	23	6 p. m.	20 mi.		25,000	do	Much damage in places. Path 25 miles	Do.
Rockingham County, Va. (western part of).	23	P. m.	20 mi.		100,000	Thunderstorm and hail.	Crops badly beaten by hail; buildings damaged by wind.	Do.
Chester County, Pa.	24	10 a. m.				Thunderstorm and wind.	Heavy property and crop loss reported	Do.
Allegany County, Md.	24	p. m.				Destructive hail	Character of damage not reported	Do.
Oshoto (near), Wyo.	24		3,520		8,000	Hail	Crops and gardens ruined; trees stripped	Do.
Charleston, Ill., and east of.	25	12.30-2 p.m.	1,760			Wind and hail	Church damaged; 50 per cent crop loss on 200 acres.	Do.
Yoder, Wyo.	25		1,760			Hail	Small grain damaged 80 to 90 per cent; minor damage to other crops.	Do.
Chacon, N. Mex.	26	3 p. m.	880-1,760			Heavy hail	Crops injured	Do.
Chattanooga, Tenn.	26-27				1,500	Thunderstorm	Streets and roads flooded; telephone service impaired.	Do.
Boone, Calhoun, Webster, Hamilton, Pocahontas, and Wright Counties, Iowa.	27				861,800	Hail	Damage principally to crops; some poultry killed.	Do.
East coast of Florida	27-28			1	3,051,000	Tropical hurricane	Some groves damaged; large quantity of fruit lost; heavy damage to buildings and celery crop.	Do.
Greene, Hamilton, and Keokuk Counties, Iowa.	28				40,000	Hail	Crops damaged about 50 per cent. Storms usually occurred in the morning.	Do.
Orangeburg, S. C.	28				2,000	Wind	Rural residences demolished	Do.
Wedgefield, S. C.	28					Tornado	Minor damage reported	Do.
Wilmar, Minn.	28					Hail and wind	Crops injured, other minor damage	Do.
Mount Carroll, Ill.	29	6.16-7.15 a. m.			1,100	Electrical	Electric lines damaged	Do.
Franklin County, Iowa	29	6 p. m.	3,520			Hail	Crop loss about 50 per cent; path 4 miles	Do.
Dunn, N. C.	29					Wind and rain	Crops, trees, and a few small houses damaged	Do.
Redwood Falls, Minn.	29					Wind	Some damage over limited area	Do.
Ottawa, Ill.	30	2.30 p. m.				Wind, rain, and electrical.	Trees blown down; much damage by flooding: 800 telephones out of order; car service suspended.	Do.
Peoria, Ill., and vicinity	30					Electrical	A few barns burned	Do.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

The tropical disturbance that appeared east of the Leeward Islands on the 22d and passed near the island of Dominica during the following night, apparently as a storm of only moderate intensity, increased gradually in intensity as it moved west-northwestward south of the Virgin Islands and Porto Rico, San Juan reporting a maximum wind velocity of 66 miles an hour from the east on the 23d. The lowest barometer reading at San Juan was 29.70 inches, the storm center apparently passing close to the extreme southwestern part of Porto Rico the evening of the 23d as the path changed from west-northwest to northwest. The morning report of the 24th from Santo Domingo was missing, but the Port au Prince and Puerto Plata reports indicated that the center was a short distance south of Santo Domingo. However, the delayed morning report was received late in the afternoon of the 24th and it showed that the storm center had already passed the extreme eastern point of the island and was moving northwestward along or near the coast line.

In the advisory warnings sent out up to and including the morning of the 24th the direction of movement of the storm was given as west-northwest, but caution was advised for all vessels bound for the region south of latitude 25° N., which is the latitude of Nassau, Bahamas, and on the morning of the 24th this area was extended to include the Bahama Islands and neighboring waters. Upon receipt of the delayed morning report from Santo Domingo the following advisory warning was sent out:

Advisory, 5 p. m. (24th).—Tropical storm will likely pass between Turks Island and Great Inagua to-night, moving northwestward or west-northwestward. No further danger in Caribbean Sea.

At 8 p. m. the barometer at Turks Island read 29.68 inches, and the wind which had reached a maximum velocity of 74 miles an hour from the northeast had shifted to southeast and decreased to 38 miles an hour. The following warning was issued at 10 p. m. of the 24th:

Hoist northeast storm warning Jupiter Inlet to Key West, Fla. Hurricane central between Turks Island and Inagua moving northwestward. Center will probably pass near Nassau early Sunday night. Increasing northeast winds along southeast Florida coast becoming strong Sunday afternoon or night. Caution advised all vessels bound toward hurricane's path.

At 8 a. m. of the 25th the barometer at Nassau had scarcely begun to fall, and the weather was clear with only 6 miles of wind from the northeast. The S. S. *Standard*, however, in latitude 24 N. and longitude 74° 30′ W., reported a barometer reading of 29.86 inches with a wind velocity of 50 miles from the east. At noon the barometer on this vessel read 29.56 inches and the wind had increased to 70 miles an hour from the northeast. By 8 p. m. the pressure at Nassau had fallen to 29.78 inches and the wind which was 34 miles an hour from the northeast at 4 p. m., had increased to 60 miles from the same direction. The following warning was issued:

Continue northeast storm warnings 10 p. m. Key West to Jupiter Inlet, Fla. Hurricane central about twenty-four north, seventy-six west moving northwestward toward Nassau. * * * Increasing northeast winds probably becoming strong Monday forenoon, especially between Jupiter and Miami. Caution advised all vessels off the east Florida coast.

No further reports were received from Nassau, where the hurricane was very severe. Unofficial reports indicated that the wind reached an estimated velocity of 135 miles an hour at that place. At 2 p. m. of the 26th, the S. S. *West Erral*, only a short distance east of Miami, reported a wind velocity of 70 miles an hour from the northeast with a rough sea. At 3.30 p. m., the following warning was issued:

Change to hurricane warnings Jupiter Inlet to Key West, Fla., and hoist northeast storm warnings north of Key West to Tampa.

Hurricane apparently central two p. m. approximately twenty-five north seventy-nine west moving west-northwestward. Indications are hurricane will move inland over extreme southern Florida late this afternoon or early to-night. Advise all interests.

The hurricane continued to move slowly northwestward and at 8 a. m. of the 27th it was central a short distance off the coast between Miami and Jupiter Inlet. A vessel, name unknown, between Cary's Fort and Bimini reported a barometer reading of 29.01 inches with winds of hurricane force and tremendously high waves at 5 a. m. This report was received several hours late. A delayed report from the S. S. *Orizaba* not far from the center showed a pressure of 29.20 inches with a wind force of 12 (Beaufort) from the north. The hurricane warnings were changed to northwest storm warnings at 10 a. m. from Key West to Miami, and northeast storm warnings were ordered north of Titusville to Charleston, S. C. At noon the following warning was issued:

Extend hurricane warnings one p. m. northward along east Florida coast to Jacksonville. Hurricane center apparently near Palm Beach moving slowly north-northwestward. * * * Emergency. Advise all interests.

At 3.40 p. m. the following warning was issued:

Hoist northeast storm warnings sunset north of Tampa to Cedar Keys and north of Charleston to Virginia Capes. Hurricane central two p. m. vicinity of Palm Beach or Jupiter, Fla., apparently moving slowly north-northwestward. S. S. *Orizaba* near hurricane center reports wind velocity hundred miles per hour.

At 9.20 p. m. the following warning was sent out:

Change to hurricane warnings ten p. m. north of Jacksonville to Charleston. Hurricane central along east Florida coast at latitude twenty-eight apparently moving north or north-northwestward. Center will pass near Titusville during the night and likely pass short distance east of Jacksonville Wednesday morning. Emergency. Advise all interests.

Northwest storm warnings were ordered displayed along the northwest Florida coast from Cedar Keys to Appalachicola at 9.30 a. m. of the 28th, and the following advisory warning was issued:

Hurricane central eight a. m. along northeast Florida coast between Titusville and Jacksonville, moving very slowly north-northwestward. Center will pass close to Jacksonville to-day and quite likely move northward near or inside the Georgia coast line.

The center passed very close to Jacksonville at about 3 p. m., when the barometer read 29.25 inches. Thereafter, the storm decreased in intensity quite rapidly, Macon, Ga., reporting 29.60 inches at 8 a. m. of the 29th, when the center was near that place. An area of high pressure that extended from Bermuda northwestward over the Middle Atlantic and North Atlantic States caused the path of the storm to be deflected toward the west. No strong winds attended the westward advance of the disturbance, which was now of only moderate intensity, as it moved over western Georgia, Alabama, and Mississippi. By 8 p. m. of the 31st the center was between Memphis, Tenn., and Cairo, Ill., after which the disturbance moved northeastward over Indiana and the lower lake region to western Quebec, where it was central the evening of August 2.

Apparently little damage was done by this tropical storm until it reached Porto Rico. The official in charge at San Juan reports as follows:

The storm caused considerable injury to crops in Porto Rico, the heaviest losses occurring in the west-central region of coffee plantations. About 25 lives were lost, mostly due to heavy floods caused by the rapid rise of the rivers. The rainfall was very heavy, especially in the mountain regions. The average rainfall of the island during the storm was 6.18 inches. The normal amount for the entire month of July is 6.50 inches.

A rough survey of losses reported by correspondents of the Climatological Service shows:

Lives lost	25
Losses to crops by—	
Wind	$1, 000, 000
Water	1, 000, 000
Other losses by—	
Wind	200, 000
Water	150, 000
Total property loss	2, 350, 000

In eastern Santo Domingo the estimated damage amounted to $3,000,000, and at Turks Island, where the wind reached a velocity of 74 miles an hour from the northeast, some property damage was done, but no loss of life has been reported.

The hurricane increased in intensity as it advanced northwestward over the Bahama group. A copy of the Nassau Guardian of July 28 was received through the State Department from the American vice consul at Nassau and an excellent description of the hurricane, taken from that paper, is printed on page 296 of this REVIEW.

Almost a page of the Guardian was devoted to detailed accounts of damage to Government buildings, churches, hotels, private homes, shipping, and telegraph and telephone lines. The wireless station went out of commission early on Sunday evening, July 25. The two new steel towers which had just been erected snapped and fell to the ground. The old towers also snapped near the top at practically the same height. No reports of loss of life in the Bahamas had been received up to the time the newspaper went to press, and no estimate was given of the approximate monetary damage, but it is doubtless very great.

The information given below is taken from the report of the official in charge, Jacksonville, Fla.

Damage to property in Florida by the hurricane is estimated as follows: Fort Pierce, $30,000; Cocoa, $50,000; Stuart, $100,000; and Palm Beach, West Palm Beach, and Lake Worth (combined), $2,000,000 to $3,000,000. At New Smyrna there was very great damage to property and about $10,000 damage to telegraph and telephone lines. Damage to crops was rather severe in the vicinity of all the places mentioned above. Stuart reports the loss of 80 per cent of the fruit crop; Fort Pierce, 50 per cent of the grapefruit and 10 per cent of the orange crop; and Cocoa reports crop losses amounting to $300,000.

Other than damages to sea walls and inundations to property exposed to the high seas the marine damage on the east coast was of little moment—due, without question, to the advance warnings of the bureau and to the implicit obedience to them. Six lives were reported lost on a fishing boat that left Apalachicola on the 22d, before the first warning of the storm was received at that place, and failed to return after the storm had passed. One life was lost at Palm Beach.

Frequent readings of the aneroid barometer were made during the progress of the hurricane at both Fort Pierce and Merrits Island (10 miles south of Titusville). At Fort Pierce the lowest reading was 28.88 inches at 4.30 p. m. of the 27th, and at Merrits Island 28.80 inches at 11.30 p. m. of the same date. Inasmuch as the distance between the two places is slightly over 70 miles, the rate of progression of the hurricane center was approximately 10 miles an hour. No estimate was made of the wind velocity at any point between Miami and Jacksonville, except at Titusville, where it was from 60 to 70 miles an hour. At Jacksonville the maximum velocity was 50 miles an hour from the east. As is usual, torrential rains attended the northward progress of the hurricane. The greatest 24-hour amounts were as follows: Jacksonville, 5.66; Sanford, 6.30; Malabar, 6.85; Fellsmere, 6.88; Titusville, 8.36; and Merritts Island, 10.02 inches.

The official in charge during his experience in 20 or more tropical storms has rarely seen such implicit obedience to the display of hurricane warnings. No ship, however staunch, wished to challenge the storm's fury, and one passenger ship returned to port after a short contest with high winds and mountainous seas. It is unquestionably true that the small property loss, as well as the small loss of life afloat, was due to the alertness in the distribution of warnings and a general observance of the same by all concerned. Expressions of appreciation and complimentary remarks on the efficiency of the bureau have been of frequent occurrence.

The official in charge at Miami reports as follows:

> The damages in the Miami district from the storm amounted to about $150,000, the greater part of which represents the loss to the avocado crop. The next greatest loss was sustained by telegraph, telephone, and electric light companies. A considerable loss also resulted from the destruction of awnings. Several houseboats and barges on Biscayne Bay that had not been taken to safe anchorage were sunk. Most of the craft in Biscayne Bay, including large dredging equipment, heeded the Weather Bureau warnings and escaped injury. Owing to the poor exposure of the anemometer at this station, the maximum wind velocity recorded, 33 miles per hour, does not represent the true wind velocity. It is estimated that the wind reached a velocity of 50 miles per hour on Biscayne Bay and at Miami Beach.

Very little damage was done by the storm after it passed north of Jacksonville. At Charleston, S. C., a few small boats were sunk, signs were blown down, and a few plate-glass windows were broken.

No other storm of marked intensity crossed the Washington forecast district during the month.—*C. L. Mitchell.*

CHICAGO FORECAST DISTRICT

The few special weather warnings issued in July, 1926, concerned shipping interests on the Great Lakes, with the exception of a warning for possibly light frost in the cranberry districts of Wisconsin on the 12th. The frost warning was verified at two of the three special cranberry stations, and the third station reported a bog minimum temperature of 33°. Advices were also sent to the cranberry interests on the 10th and 13th to the effect that while low temperatures would prevail on those nights frost was not likely. The ensuing conditions occurred as forecast.

Four disturbances of more or less importance affected the Great Lakes during the month. A few winds of storm force occurred in this connection, but they were mainly thundersqualls or winds resulting from a sudden shift as the center of the disturbance passed the meridian of the station. In all cases the duration was brief. Except in one instance, small-craft warnings were issued for these disturbances. The exception was a storm warning for extreme western Lake Superior on the night of the 8th, when the first disturbance of the month was approaching the Great Lakes. This was a slow-moving storm from the northwest that steadily deepened as it advanced, so that when the upper Mississippi Valley was reached the barometer had fallen to an unusually low point for midsummer. In fact, the lowest reduced pressures of record for July occurred over a wide area. At Chicago the reading was 29.42 inches.

Special service was given in connection with the national balloon race held on the 13th at Chicago, at the time of the Elks National Convention, and we have been advised that the winner owed his success to using the weather reports and forecasts that were furnished each of the pilots.—*C. A. Donnel.*

NEW ORLEANS FORECAST DISTRICT

Moderate weather conditions prevailed throughout the district during the whole month. No storm warnings were issued and no general storm occurred on the west Gulf coast.—*I. M. Cline.*

DENVER FORECAST DISTRICT

The usual midsummer moderately low pressures prevailed over most of the Rocky Mountain region during the greater part of the month, with frequent generally light showers and thunderstorms, especially in the northern and eastern portions of this district.

Daily weather and temperature forecasts which contained predictions as to wind direction and velocity in New Mexico and Arizona were sent to the district forester, Albuquerque, N. Mex., from the 1st to the 15th, inclusive, and wind forecasts during the same period were included in the forecast telegram to the official in charge, Santa Fe, N. Mex. Daily forecasts of weather, temperature, and wind direction and velocity for western Montana were also sent to the official in charge, Spokane, Wash., to be used in forest-protection work.

No special warnings were required during the month.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT

The month was marked by a continuation of temperatures above the normal over practically all interior sections and by subnormal precipitation. Consequently, many warnings for fire-weather conditions in the forests were issued. Fires were frequent as a result of the prevailing wind, temperature and humidity conditions. Many of them were man-made but a number were caused by electrical discharges in the forested areas in the mountains. No storm warnings were issued; none were required.

The demand for citrus fruits during the summer months is largely governed by the weather conditions. A warm wave over the Middle Western and Eastern states, the principal consuming sections, brings about a greatly increased demand for lemons and oranges. Naturally the California Citrus Growers Exchange is interested in information of impending hot waves over these areas, in order to meet this increased demand. On the 16th the following information was sent to Mr. E. G. Dezell, general manager of this organization: "Weather chart indicates several days of warm weather over Middle Western and Eastern States." Acknowledging receipt of this advice, Mr. Dezell on the same date wrote as follows:

> Thank you very much indeed for your flash wire this morning with reference to the indications for several days of warm weather over the Middle Western and Eastern States. This changes last week's forecast and is very acceptable from the standpoint of the market of both lemons and oranges and this early advice is very much appreciated.

—*E. H. Bowie.*

RIVERS AND FLOODS

By H. C. FRANKENFIELD

The only floods of importance during July were those in the Sulphur River. Intermittent rains following the 8th at intervals of a few days kept this stream near or above the flood stage at Ringo Crossing, Tex., from the 10th, and at Finley, Tex., from the 18th, to the close of

the month. Flood warnings were issued in time to prevent any loss of livestock or other movable property, the reported saving thereby being $50,300. Unavoidable losses were estimated at $53,500.

Reported losses in other districts were as follows: Trinity River, $1,500; Cypress River, $200; Tar River, reported as "considerable above Louisburg, N. C."

An effect of the deficient snowfall and subnormal precipitation of the winter and early spring in the Pacific Northwest appeared in the unusually low maximum stages reached during the annual rise in the Columbia River. These stages, for all stations, were the lowest summer crests of record. Comparative data follow:

Station	Summer maximum this year	Previous lowest summer maximum	Previous highest maximum
Marcus, Wash	19.8	27.5 in 1919	44.7 in 1894
Umatilla, Oreg	11.9	13.6 in 1915	34.5 in 1894
Celilo, Oreg	8.9	10.5 in 1915	23.4 in 1903
The Dalles, Oreg	17.1	20.8 in 1915	59.4 in 1894
Cascade Locks, Oreg	12.9	14.7 in 1880	49.7 in 1894
Vancouver, Wash	9.9	12.6 in 1915	34.4 in 1894
Portland, Oreg	9.7	10.0 in 1889	33.0 in 1894

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE	Feet			Feet	
Tar, Rocky Mount, N. C	9	29	30	10.2	29
Santee, Rimini, S. C	12	31	(1)		
MISSISSIPPI DRAINAGE					
Solomon, Beloit, Kans	18	13	15	21.0	15
Canadian, Logan N. Mex	4			5.0	24
Sulphur:					
Ringo Crossing, Tex	20	10	19	25.0	16
		22	30	23.4	28
Finley, Tex	24	17	24	26.1	19–20
		29	(1)		
Cypress, Jefferson, Tex	18	19	20	18.5	20
WEST GULF DRAINAGE					
Trinity:					
Dallas, Tex	25	15	17	27.1	16
		24	(1)		
Trinidad, Tex	28	16	23	33.6	21
Little, Little River, Tex	30	23	23	34.4	23
PACIFIC DRAINAGE					
Colorado, Parker, Ariz	7	(2)	24	10.2	June 12–13

[1] Continued at end of month. [2] Continued from last month.

MEAN LAKE LEVELS DURING JULY, 1926

By UNITED STATES LAKE SURVEY

[Detroit, Mich., August 5, 1926]

The following data are reported in the Notice to Mariners of the above date:

Data	Lakes [1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during July, 1926.	Feet	Feet	Feet	Feet
Above mean sea level at New York	600.86	578.53	571.22	245.20
Above or below—				
Mean stage of June, 1926	+0.36	+0.12	±0.00	−0.11
Mean stage of July, 1925	−0.57	−0.01	+0.10	−0.01
Average stage for July, last 10 years	−1.48	−2.12	−1.47	−1.42
Highest recorded July stage	−2.96	−5.05	−3.19	−3.52
Lowest recorded July stage	−0.46	−0.01	+0.10	+0.61
Average departure (since 1860) of the July level from the June level	+0.21	+0.06	−0.04	−0.04

[1] Lake St. Clair's level: In July, 1926, 573.94 feet.

EFFECT OF THE WEATHER ON CROPS AND FARMING OPERATIONS, JULY, 1926

By J. B. KINCER

General summary.—Early in the month a reaction to warmer weather throughout the Central and Northern States promoted rapid growth of vegetation wherever there was sufficient soil moisture. The need for rain, however, had become urgent in a great many places, especially over a considerable area comprising the central and northern Plains and parts of the central valleys. By the 20th of the month good rains were needed over large areas, especially the interior valley States, parts of the South, and generally over the Northwest, with the drought severe in the central Plains and in the extreme lower Ohio Valley.

In the more western States irrigated crops made excellent growth, but the warm, dry weather exacted a heavy toll on irrigation water, and dry-land crops were unfavorably affected. About the close of the month a tropical storm passed inland from the Southeast, and heavy rains occurred in some sections of that area. While these were damaging to crops in a few sections, droughty conditions in the interior of the Southeast and also in most parts of the Ohio Valley were effectively relieved, while additional moisture in the middle Atlantic area was helpful.

Small grains.—The harvest of winter wheat made good progress under favorable weather conditions. At the beginning of the month cutting had advanced in the East well to the north of the lower Ohio River, and in the Plains States to southeastern and south-central Kansas. By the 20th, harvest had been about completed in the principal producing sections, and threshing was making good advance. The warm, dry weather in the Central-Northern States, however, was unfavorable for spring wheat and also for oats in many places. In general, the month was unfavorable for spring wheat, as rainfall was mostly of a local character and insufficient over considerable areas. Harvest was begun the latter part of the month in Minnesota and parts of North Dakota.

Corn.—The reaction to warmer weather early in the month was generally beneficial for corn, though it was too dry in some sections, especially in the lower Ohio Valley and central Plains States. The drought was largely relieved at about the close of the month in the former area, but continued in the central trans-Mississippi States. In Iowa early corn was damaged badly by heat and drought, especially in the Northwest, and much harm was done in parts of Nebraska and Kansas. In the Southwest the weather was generally favorable.

Cotton.—The weather was mostly favorable for the cotton crop, although moisture was needed in some interior southeastern districts, and there was too much rain in some sections, with considerable complaint of shedding, poor fruiting, and insect activity. The latter part of the month had rather less insect activity, but frequent rains over considerable areas, especially in the central and eastern portions of the belt, were unfavorable, and reports of poor fruiting were rather numerous.

Miscellaneous crops.—Pastures did well generally in the Northeast, but there was insufficient rain for grass lands in Central and Northern States between the Mississippi River and Rocky Mountains, and quite generally in the more western range country. Livestock, however, continued mostly in satisfactory condition.

Potatoes did well in the Southeast, while showers in the Ohio Valley and Northern States near the close of the month were beneficial. Gardens, truck, and minor crops in the interior States had insufficient moisture during much of the month.

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, July, 1926

Section	Temperature		Monthly extremes						Precipitation		Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	79.1	−1.0	Talladega	104	21	3 stations	49	[2] 15	6.13	+0.68	Robertsdale	11.18	Florence	1.24
Arizona	79.3	−0.5	Gila Bend	120	6	Bright Angel	26	10	1.84	−0.67	Santa Marguerita	6.65	4 stations	0.00
Arkansas	79.8	−0.2	Searcy	109	4	Lambrook	42	15	3.55	−0.27	Lutherville	8.03	Helena	0.61
California	74.0	+1.5	Greenland Ranch	125	16	2 stations	30	[2] 8	0.07	0.00	Gem Lake	1.93	181 stations	0.00
Colorado	64.5	−1.0	3 stations	105	[2] 18	Hermit	26	9	2.50	+0.13	Silverton	5.74	La Junta	0.31
Florida	80.8	−0.3	3 stations	99	[2] 21	Garniers	59	16	9.39	+2.00	Merritts Island	22.78	Fernandina	3.30
Georgia	79.5	−0.3	Lisbon	110	21	Blue Ridge	46	17	6.68	+0.97	St. George	13.94	Dahlonega	2.73
Idaho	70.4	+2.2	Murphy	109	12	Warren	27	21	0.59	−0.18	Grace	2.84	2 stations	0.00
Illinois	76.5	+0.5	Mount Carmel	107	3	Mount Carroll	44	14	3.54	+0.23	Morrison	8.22	Windsor	0.55
Indiana	75.7	+0.4	Vincennes	106	3	Monticello	41	15	3.30	−0.10	Forest Reserve	8.10	Evansville	0.80
Iowa	74.8	+1.0	Inwood	109	[2] 19	Decorah	38	14	3.72	−0.13	Clinton	9.08	Cumberland	0.82
Kansas	78.8	+0.6	Cawker City	110	1	St. Francis	47	15	2.51	−0.94	St. Francis	7.03	Tribune	0.60
Kentucky	77.6	+0.7	Hopkinsville	107	3	Middlesboro	43	15	4.36	+0.19	Hazard	10.72	Paducah	0.83
Louisiana	81.4	−0.2	Dodson	105	3	Lake Providence	50	15	4.67	−1.75	Ruston	10.78	Ville Platte	1.09
Maryland-Delaware	74.9	−0.3	2 stations	107	[2] 21	Oakland, Md	38	12	5.85	+1.52	Milford, Del	15.20	Ferry Landing, Md.	1.91
Michigan	68.2	−0.5	Monroe	102	[2] 20	3 stations	31	[2] 10	2.20	−0.75	Painesdale	5.87	Hillsdale	0.42
Minnesota	69.9	+0.6	New Ulm	107	16	Itasca State Park	32	12	2.90	−0.69	Pokegama Falls	7.11	Beardsley	0.76
Mississippi	80.5	−0.3	3 stations	104	[2] 2	Batesville	48	15	4.04	−1.11	Fruitland Park	10.04	Rosedale	0.71
Missouri	78.0	+0.6	Marble Hill	108	2	Goodland	40	24	3.14	−0.91	Sikeston	8.65	Valley Park	0.49
Nebraska	75.7	+1.1	Hayes Center	112	19	Gordon	38	31	2.75	−0.65	Purdum	5.88	Western	0.66
Nevada	74.1	+0.9	Logandale	116	16	Rye Patch	33	21	0.43	+0.02	Alamo	1.33	4 stations	0.00
New England	67.6	−1.4	Waterbury, Conn	105	22	2 stations	30	[2] 4	3.74	−0.37	Taunton, Mass	6.17	Eastport, Me	1.15
New Jersey	73.0	−0.6	Phillipsburg	105	22	Belleplain	40	12	5.46	+0.82	Atlantic City	8.51	Layton	1.29
New Mexico	70.2	−1.5	Hobbs	107	9	Senorito (near)	28	9	2.45	−0.20	Cuervo	6.51	Vance (near)	0.22
New York	68.9	−0.7	Troy	108	22	Allegany State Park	32	14	3.35	−0.57	New York City	7.47	Hemlock	1.30
North Carolina	77.5	+1.2	2 stations	108	21	Parker	34	16	5.46	−0.80	Altapass	11.65	Swansboro	1.58
North Dakota	70.3	+2.8	2 stations	108	18	Hansboro	32	12	2.00	−0.61	Amenia	5.10	Foxholm	0.31
Ohio	72.9	−0.6	Lancaster	103	21	2 stations	40	[2] 2	4.29	+0.46	Cincinnati, Government building.	10.29	2 stations	0.83
Oklahoma	79.6	−1.4	Okeene	108	5	Smithville	49	15	4.10	+1.26	Tishomingo	11.49	Goodwell	0.47
Oregon	69.6	+2.3	Echo	114	11	Fremont	25	20	0.17	−0.35	Starkey	2.47	39 stations	0.00
Pennsylvania	71.8	−0.1	Gettysburg	105	21	West Bingham	35	[2] 12	3.82	−0.53	Point Breeze, Philadelphia.	10.63	South Sterling	1.14
South Carolina	80.5	+0.7	7 stations	108	21	Caesar's Head	50	[2] 15	6.24	+0.35	Due West	10.98	Mars Bluff	2.40
South Dakota	73.8	+2.0	Academy	114	19	Castlewood	37	13	2.77	+0.01	Aberdeen	7.01	Oelrichs	0.27
Tennessee	77.0	+0.6	Cedar Hill	107	3	Crossville	40	15	3.36	−1.19	Copperhill	6.91	Jefferson City	1.13
Texas	81.2	−1.7	Encinal	110	31	Throckmorton	47	16	3.87	+1.26	Paris	14.71	Buena Vista	T.
Utah	71.2	−0.3	St. George	110	16	2 stations	32	8	1.09	+0.11	Trout Creek Ranger Station.	3.49	Big Plains	0.00
Virginia	76.2	+0.8	Woodstock	107	22	Burkes Garden	31	16	4.25	−0.24	Ashland	9.36	Speers Ferry	0.90
Washington	68.7	+2.4	Wahluke	113	11	Chewelah	32	28	0.08	−0.60	Irene Mountain	1.60	47 stations	0.00
West Virginia	72.6	−0.2	2 stations	106	[2] 21	3 stations	37	[2] 12	4.45	+0.05	Dam 19, Ohio River	8.07	Organ Cave	0.83
Wisconsin	68.8	−0.5	2 stations	104	20	Prentice	32	13	3.81	+0.17	Mondovi	9.74	Shawano	0.98
Wyoming	65.6	0.0	Clark	105	17	Gallatin	25	21	2.14	+0.58	Oshoto (near)	7.45	2 stations	0.18
Alaska (June)	55.7	+3.7	2 stations	89	18	Candle	22	3	2.61	+0.06	Fortmann Hatchery.	12.36	White Mountain	0.02
Hawaii	75.2	+1.3	2 stations	94	[2] 17	Kula Sanitarium	50	7	3.79	−2.03	Eke	19.00	4 stations	0.00
Porto Rico	79.0	+0.3	Aguirre	99	27	Aibonito	56	12	10.69	+4.18	Maricao	26.40	Ponce	3.17

[1] For description of tables on charts, see REVIEW, January, 1926, p. 32.

[2] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, July, 1926*

District and station	Elevation of instruments			Pressure			Temperature of the air										Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation			Wind					Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Barometer above sea level	Thermometer above ground	Anemometer above ground	Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range				Total	Departure from normal	Days with 0.01, or more	Total movement	Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date						
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England							67.6	−1.3										78	3.07	−0.5										5.0		
Eastport	76	67	85	29.86	29.94	+.01	60.0	−0.4	83	28	70	47	2	50	29	57	55	85	1.15	−2.3	14	5,512	s.	34	ne.	10	7	12	12	5.9	0.0	0.0
Greenville, Me.	1,070	6		28.82	29.97		64.1		92	22	77	39	5	52	40				1.23		13	3,586	nw.	23		22	15	9	7		0.0	0.0
Portland, Me.	103	82	117	29.85	29.97	+.02	66.1	−2.0	100	22	74	52	6	58	32	60	56	74	2.03	−1.2	11	5,227	s.	37	nw.	22	13	11	7	4.8	0.0	0.0
Concord	289	70	79	29.68	29.96	.00	68.1	−0.4	100	22	80	46	8	56	37				2.26	−1.5	8	3,044	se.	30	w.	22	18	8	5	4.0	0.0	0.0
Burlington	403	11	48	29.52	29.95	+.01	66.6	−3.7	91	22	77	46	5	56	33				2.64	−1.1	11	5,596	s.	38	s.	12	10	12	9	5.4	0.0	0.0
Northfield	876	12	60	29.04	29.97	+.03	64.0	−1.9	93	22	77	38	5	51	41	60	57	79	3.88	+0.2	12	4,183	s.	23	s.	17	6	18	7	5.9	0.0	0.0
Boston	125	115	188	29.83	29.97	.00	70.5	−1.2	103	22	78	56	14	63	28	63	58	68	6.06	+2.7	10	5,667	sw.	30	nw.	18	8	13	10	5.6	0.0	0.0
Nantucket	12	14	90	29.96	29.97	−.01	67.2	−0.6	86	22	74	55	27	60	20	63	61	86	3.53	+0.8	8	9,802	sw.	38	sw.	21	10	10	11	5.7	0.0	0.0
Block Island	26	11	46	29.94	29.96	−.01	67.6	−0.8	92	22	73	57	5	62	23	63	61	86	3.09	−0.2	12	9,600	sw.	49	nw.	18	16	8	7	4.1	0.0	0.0
Providence	160	215	251	29.80	29.97	.00	70.4	−3.0	100	22	80	54	6	61	30	63	59	70	2.88	−0.6	10	6,951	nw.	56	nw.	18	13	7	11	5.3	0.0	0.0
Hartford	159	122		29.80	29.96	−.01	71.9	+0.3	101	22	82	54	5	61	31				3.17	−0.9	14		s.				14	10	7	4.3	0.0	0.0
New Haven	106	74	153	29.86	29.97	.00	71.7	−0.1	101	22	81	55	5	63	29	64	61	74	3.06	−1.7	13	6,041	sw.	36	nw.	22	13	12	6	4.4	0.0	0.0
Middle Atlantic States							74.6	−0.1										73	4.62	+0.2										5.2		
Albany	97	102	115	29.85	29.95	−.01	72.8	+0.2	102	22	84	53	12	62	34	64	60	67	2.12	−1.8	10	4,606	s.	30	w.	22	13	15	3	4.0	0.0	0.0
Binghamton	871	10	84	29.07	29.99	+.02	69.6	−0.2	96	22	82	45	12	58	36				3.14	−0.4	9	3,250	sw.	39	sw.	22	9	11	11	5.9	0.0	0.0
New York	314	414	454	29.64	29.97	−.01	73.2	−0.6	97	22	81	55	16	65	27	65	61	72	7.47	+2.9	13	9,521	s.	64	nw.	10	10	8	13	5.8	0.0	0.0
Harrisburg	374	94	104	29.58	29.98	.00	75.0	+0.2	101	22	84	56	14	66	30	65	60	64	3.94	+0.1	14	4,444	ne.	32	sw.	18	10	8	13	5.8	0.0	0.0
Philadelphia	114	123	190	29.86	29.98	.00	75.5	−0.5	100	22	84	57	15	66	29	69	66	76	8.40	+4.1	14	5,750	sw.	34	ne.	15	10	9	12	5.4	0.0	0.0
Reading	325	81	98	29.63	29.97		75.2		102	21	85	54	12	65	29	67	64	72	5.73	+1.5	15	3,973	sw.	27	nw.	22	12	12	7	4.5	0.0	0.0
Scranton	805	111	119	29.14	29.99	+.01	71.4	−0.3	98	22	83	46	12	60	33	63	58	65	2.47	−1.4	12	4,349	nw.	29	nw.	22	7	9	15	6.8	0.0	0.0
Atlantic City	52	37	172	29.92	29.97	−.01	72.4	+0.3	100	21	78	58	12	67	30	68	66	83	8.51	+4.7	14	11,290	s.	56	n.	18	13	9	9	4.9	0.0	0.0
Cape May	17	13	49				74.4	+1.0	98	21	81	58	27	68	26				6.60	+2.8	12		s.								0.0	0.0
Sandy Hook	22	10	55	29.94	29.96		72.7		99	22	80	57	16	66	25	66	63	78	5.47		13	8,966	s.	56	n.	18	10	11	10	5.1	0.0	0.0
Trenton	190	159	183	29.77	29.97		74.0		101	22	83	56	12	65	29	67	63	74	5.15	+0.4	16	6,320	sw.	38	ne.	15	11	11	9	4.8	0.0	0.0
Baltimore	123	100	113	29.84	29.96	−.02	77.4	+0.2	102	21	86	60	15	69	28	69	65	69	5.74	+0.9	13	4,955	sw.	34	sw.	10	12	8	11	5.3	0.0	0.0
Washington	112	62	85	29.85	29.96	−.04	76.7	−0.1	104	21	86	57	12	67	32	69	65	71	4.20	−0.4	13	3,867	sw.	45	nw.	10	13	7	11	5.0	0.0	0.0
Cape Henry	18	8	54	29.95	29.97		78.6		100	10	86	64	16	71	25	72	70	79	1.88	−4.0	10	7,981	sw.	39	nw.	6	9	13	9	5.2	0.0	0.0
Lynchburg	681	153	188	29.26	29.98	−.03	77.8	+0.3	103	21	89	55	15	67	35	68	65	70	2.71	−1.3	9	4,170	w.	52	n.	10	13	10	8	4.9	0.0	0.0
Norfolk	91	170	205	29.89	29.98	−.02	78.9	+0.2	101	21	87	61	16	71	28	71	68	75	1.03	−4.8	8	8,486	s.	34	nw.	15	9	10	12	5.5	0.0	0.0
Richmond	144	11	52	29.83	29.98	−.03	77.6	−0.9	100	22	87	56	16	68	28	71	68	79	7.17	+2.8	11	4,776	sw.	33	n.	10	13	9	9	4.5	0.0	0.0
Wytheville	2,304	49	55	27.69	29.98	−.03	71.4	−1.2	96	21	83	47	16	60	35	64	61	74	2.30	−2.1	14	3,476	w.	19	w.	9	10	14	7	5.2	0.0	0.0
South Atlantic States							79.5	+0.4										76	5.60	−0.4										5.4		
Asheville	2,253	70	84	27.72	30.00	−.02	72.8	+1.1	96	22	83	49	16	62	32	64	61	75	4.48	−0.3	17	4,460	nw.	31	nw.	10	11	15	5	4.9	0.0	0.0
Charlotte	779	55	62	29.17	29.98	−.04	80.1	+1.7	103	22	90	60	15	70	29	70	65	67	3.96	−1.5	11	2,781	ne.	20	nw.	10	11	11	9	4.9	0.0	0.0
Hatteras	11	11	50	29.98	29.99	−.02	78.4	+0.2	91	11	84	66	20	73	20	74	73	84	1.68	−4.4	6	8,518	sw.	30	sw.	25	12	13	6	4.7	0.0	0.0
Raleigh	376	103	110	29.59	29.98	−.04	79.5	+0.7	102	21	89	58	15	70	28	70	67	72	3.59	−2.5	10	5,097	sw.	22	nw.	13	13	8	10	5.0	0.0	0.0
Wilmington	78	81	91	29.92	30.00	−.01	80.0	+0.9	98	10	87	63	16	73	23	74	73	82	3.68	−3.3	10	5,492	sw.	22	e.	28	8	12	11	5.4	0.0	0.0
Charleston	48	11	92	29.94	29.99	−.04	81.2	−0.2	97	10	87	67	15	76	20	75	73	81	4.29	−3.0	14	7,357	sw.	24	se.	28	6	15	10	6.3	0.0	0.0
Columbia, S. C.	351	41	57	29.61	29.98	−.04	81.0	+0.1	104	20	90	62	15	72	28	72	69	73	8.79	+2.7	14	5,016	sw.	25	sw.	6	9	13	9	5.5	0.0	0.0
Due West	711	10	55	29.25	30.01		80.4		105	21	92	61	15	69	33				10.98		11	6,071	sw.	47	nw.	6	7	20	4	5.0	0.0	0.0
Greenville, S. C.	1,039	139	146	28.91	29.97		79.8	+2.9	103	21	90	62	15	70	30	68	63	65	4.29		14	5,990	ne.	35	ne.	22	10	15	6	4.9	0.0	0.0
Augusta	182	62	77	29.78	29.97	−.05	81.3	0.0	103	20	91	63	15	72	30	73	71	77	4.50	−0.8	14	3,972	s.	27	n.	1	8	18	5	5.2	0.0	0.0
Savannah	65	150	194	29.91	29.98	−.05	80.4	−1.1	99	21	87	68	17	73	25	74	72	83	10.20	+4.0	16	8,479	s.	48	se.	28	6	15	10	6.0	0.0	0.0
Jacksonville	43	209	245	29.93	29.98	−.05	80.2	−1.9	94	25	87	69	14	73	19	74	72	81	10.81	+4.6	19	8,404	sw.	50	e.	28	5	11	15	6.5	0.0	0.0
Florida Peninsula							82.2	0.0										78	8.12	+2.0										6.4		
Key West	22	10	64	29.95	29.98	−.05	83.2	−0.3	92	14	89	71	2	77	20	77	74	76	5.68	+2.1	17	5,930	se.	36	n.	15	10	13	8	5.4	0.0	0.0
Miami	25	71	79	29.97	30.00		81.6	−0.3	90	28	87	69	1	76	18	76	74	79	15.22	+9.0	17	3,860	se.	33	ne.	26	5	12	14	7.1	0.0	0.0
Tampa	35	79	87	29.95	29.98	−.06	81.9	+0.7	94	25	89	69	28	74	18	75	73	80	3.46	−5.0	13	4,340	e.	34	n.	28	4	17	10	6.2	0.0	0.0
Titusville	44	5		29.93	29.98		81.1		98	11	90	68	13	72	26				18.08		18		s.				6	12	13	6.8	0.0	0.0
East Gulf States							80.0	−0.7										74	5.23	−0.1										5.2		
Atlanta	1,173	190	216	28.78	29.99	−.03	78.5	+0.4	100	21	87	59	15	70	25	68	64	69	4.49	−0.2	14	6,880	w.	54	nw.	10	11	8	12	5.7	0.0	0.0
Macon	370	78	87	29.59	29.98	−.04	79.4	−1.8	100	21	89	60	16	70	28	71	68	74	4.24	−0.4	12	4,267	s.	35	ne.	20	13	11	7	4.6	0.0	0.0
Thomasville	273	49	58	29.69	29.98	−.05	79.7	−2.1	97	21	88	67	16	71	23	72	70	79	7.06	+1.7	17	3,113	sw.	21	sw.	29	3	14	14	6.7	0.0	0.0
Apalachicola	36	42	49	29.94	29.98		80.4		92	21	86	71	4	74	18	75	73	80	3.66		15	5,318	sw.	29	n.	28	11	15	5	4.5	0.0	0.0
Pensacola	56	149	185	29.92	29.98	−.03	80.4	−0.6	94	28	86	68	23	75	20	74	72	76	5.26	−2.0	10	8,472	sw.	51	nw.	10	9	11	11	5.4	0.0	0.0
Anniston	741	9	57	29.23	30.01	−.01	78.0	+0.1	99	21	90	52	16	66	36				6.95	+2.2	14	2,820	s.	23	nw.	10	14	13	4	4.1	0.0	0.0
Birmingham	700	11	48	29.24	29.99	−.02	79.2	−1.0	98	20	90	58	15	69	30	70	66	71	2.45	−2.2	14	3,840	s.	24	nw.	10	14	9	8	4.6	0.0	0.0
Mobile	57	125	161	29.91	29.97	−.04	81.9	+0.5	96	2	90	67	16	73	24	74	71	76	5.93	−1.1	14	5,698	sw.	37	ne.	28	6	16	9	5.4	0.0	0.0
Montgomery	223	100	112	29.74	29.98	−.04	79.8	−1.9	97	21	89	62	16	71	26	71	68	72	6.55	+1.9	15	4,358	w.	38	ne.	22	11	13	7	4.8	0.0	0.0
Corinth	469	6					80.6		102	2	92	49	15	69	35				3.08		11						6	23	2		0.0	0.0
Meridian	375	87	95	29.58	29.97	−.05	79.0	−1.4	97	2	89	52	16	69	36	71	68	74	4.67	+0.2	13	3,299	sw.	30	e.	3	13	11	7	4.8	0.0	0.0
Vicksburg	247	65	73	29.71	29.99	−.01	80.6	−0.7	98	3	90	59	16	72	26	71	67	70	5.68	+1.3	13	3,982	w.	32	w.	8	11	10	10	5.2	0.0	0.0
New Orleans	53	76	84	29.92	29.97	−.03	83.1	+0.7	95	2	90	66	25	76	25	75	72	74	4.20	−2.3	10	4,129	sw.	31	e.	3	6	14	11	6.0	0.0	0.0
West Gulf States							81.1	−1.4										75	3.69	+0.6										4.7		
Shreveport	249	77	93	29.70	29.96	−.02	81.3	−1.9	101	4	90	63	15	72	24	73	70	75	6.57	+2.8	14	4,006	e.	24	s.	8	19	6	6	3.7	0.0	0.0
Bentonville	1,303	11	44				76.1	−2.4	96	4	88	51	14	65	31				6.54		7	2,557	s.	26	se.	7	18	8	5		0.0	0.0
Fort Smith	457	79	94	29.48	29.94	−.03	80.2	−1.3	100	4	91	59	15	70	29	71	67	70	3.64	−0.2	12	4,101	e.	39	nw.	9	14	11	6	4.3	0.0	0.0
Little Rock	357	136	144	29.58	29.95	−.04	81.2	+0.3	103	4	92	60	15	71	30	70	65	65	3.42	−0.6	9	5,025	s.	38	n.	10	15	10	6	3.8	0.0	0.0
Brownsville	57	53	61	29.85	29.91		82.0	−1.6	94	31	88	71	4	76	18	76	74	84	3.81		10	4,980	s.	22	s.	7	12	11	8	4.9	0.0	0.0
Corpus Christi	20	11	73	29.92	29.94	−.02	82.4	−0.3	96	13	88	73	4	77	19	76	75	81	1.30	−0.4	7	8,466	se.	28	se.	23	11	9	11	5.3	0.0	0.0
Dallas	512	109	117	29.42	29.95		81.1		97	4	90	67	15	72	25				5.97		10	4,851	s.	35	nw.	7	18	6	7	3.8	0.0	0.0
Fort Worth	670	106	114	29.23	29.93	−.03	81.4	−2.2	100	30	91	66	16	72	28	71	67	69	4.13	+1.6	9	4,898	s.	42	sw.	7	12	14	5	4.7	0.0	0.0
Galveston	54	106	114	29.92	29.98	.00	82.4	−1.0	92	29	87	71	14	78	13	76	74	80	5.00	+1.0	10	6,304	s.	24	se.	22	6	20	5	5.1	0.0	0.0
Groesbeck	461	11	56	29.48	29.95		80.2		95	31	90	65	16	71	25				4.60		8	5,656	s.	33	ne.	10	15	12	4	4.4	0.0	0.0
Houston	138	292	314	29.82	29.96		82.4	−1.3	95	12	90	69	22	74	20				2.58		11	7,129	e.	36	s.	22	6	16	9	5.4	0.0	0.0
Palestine	510	64	72	29.44	29.95	−.02	80.0	−2.2	94	3	89	64	16	71	24	73	71	78	4.25	+1.2	12	4,132	s.	30	ne.	10	7	18	6	5.0	0.0	0.0
Port Arthur	34	58	66	29.92	29.96		82.6		97	30	90	71	22	75	20				5.24		16	5,363	s.	31	ne.	4	9	15	7	5.2	0.0	0.0
San Antonio	693	119	132	29.22	29.93	−.02	82.2	−1.6	99	30	92	68	2	72	26	73	69	71	1.37	−0.8	7	5,100	s.	32	se.	10	8	16	7	5.2	0.0	0.0
Taylor	583	55	63	29.38	29.99	+.03	81.8	−0.9	96	30	91	68	16	72	26				3.57	+1.0	9	4,988	s.	34	se.	10	9	17	5	4.7	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, July, 1926*—Continued

District and station	Elevation of instruments: Barometer above sea level	Thermometer above ground	Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Days with 0.01, or more	Wind: Total movement	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0–10	In.	In.
Ohio Valley and Tennessee							76.6	+0.1										66	4.40	+0.3										4.7		
Chattanooga	762	189	213	29.17	29.96	−.06	78.6	+0.2	100	20	89	59	15	69	32	68	64	68	5.77	+1.9	17	4,783	sw.	42	nw.	25	10	14	7	5.2	0.0	0.0
Knoxville	995	102	111	28.95	29.98	−.04	78.2	+1.1	99	20	89	56	16	67	30	68	64	69	2.44	−1.8	7	3,990	ne.	29	sw.	3	11	12	8	4.5	0.0	0.0
Memphis	399	76	97	29.54	29.95	−.05	80.8	+0.1	99	3	90	61	15	72	25	71	66	65	2.19	−1.3	9	4,535	sw	47	ne.	4	16	9	6	3.8	0.0	0.0
Nashville	546	168	191	29.41	29.98	−.03	79.8	+0.7	101	2	90	54	15	70	31	69	65	65	3.68	−0.7	10	5,083	sw.	33	w.	10	14	10	7	4.5	0.0	0.0
Lexington	989	193	230	28.94	29.99	−.02	76.8	+0.9	97	21	86	55	14	68	25				5.95	+1.5	13	8,138	sw.	52	ne.	6	18	9	4	3.5	0.0	0.0
Louisville	525	188	234	29.41	29.98	−.02	78.8	+0.2	101	3	88	57	14	69	28	68	63	63	2.73	−1.0	9	6,653	s.	45	w.	10	11	14	6	4.6	0.0	0.0
Evansville	431	139	175	29.51	29.97	−.03	80.6	+1.9	100	3	91	59	14	70	29	69	63	59	0.80	−3.0	9	5,313	sw.	40	nw.	22	7	21	3	4.9	0.0	0.0
Indianapolis	822	194	230	29.10	29.96	−.03	76.2	+0.5	97	3	86	52	14	66	29	65	59	60	3.78	−0.4	10	7,608	e.	42	sw.	9	11	13	7	5.0	0.0	0.0
Royal Center	736	11	55	29.18	29.97		73.5		96	21	86	48	14	62	34				1.87		10	6,782	e.	34	w.	9	10	13	8	4.8	0.0	0.0
Terre Haute	575	96	129	29.34	29.95		78.2		99	3	89	53	14	68	31	67	61	61	2.71		8	6,211	sw.	42	nw.	3	8	21	2	5.0	0.0	0.0
Cincinnati	627	11	51	29.31	29.98	−.02	75.2	+0.1	96	21	85	54	11	65	27	67	63	69	10.02	+6.5	11	4,205	sw.	44	sw.	10	13	11	7	4.4	0.0	0.0
Columbus	822	179	222	29.13	29.99	−.01	74.2	−0.7	98	21	84	53	14	64	27	65	60	64	4.47	+0.8	9	6,426	e.	46	nw.	18	11	11	9	4.9	0.0	0.0
Dayton	899	137	173	29.02	29.94		74.8	−0.6	97	21	85	54	11	64	31	65	60	64	5.03	+1.8	13	5,835	ne.	60	nw.	6	12	13	6	4.5	0.0	0.0
Elkins	1,947	59	67	28.01	30.00	−.01	69.3	−1.0	94	22	80	44	16	58	36	63	61	81	4.57	−0.1	13	2,933	w.	32	w.	18	9	10	12	6.0	0.0	0.0
Parkersburg	637	77	82	29.36	30.01	.00	74.9	−0.5	99	21	85	53	[illegible]	64	31	67	63	72	7.38	+2.7	13	3,216	se.	67	nw.	18	14	7	10	4.9	0.0	0.0
Pittsburgh	842	353	410	29.00	29.98	−.02	73.5	−1.1	97	21	83	53	16	64	30	64	59	63	1.72	−2.7	7	7,162	sw.	34	sw.	10	8	11	12	6.0	0.0	0.0
Lower Lake Region							70.3	−1.2										66	2.33	−1.0										4.6		
Buffalo	767	247	280	29.15	29.96	−.01	67.7	−2.1	82	19	75	51	13	60	28	63	60	74	2.17	−1.2	10	10,191	sw.	54	sw.	12	15	8	8	4.5	0.0	0.0
Canton	448	10	61	29.49	29.96		66.4	4.1	82	21	77	44	4	56	33				3.40	+0.2	12	5,617	sw.	49	w.	12	19	8	4	3.8	0.0	0.0
Oswego	335	76	91		29.96	.00	67.2	−3.2	89	9	76	48	14	58	30			71	2.82	−0.4	7	4,958	s.	23	sw.	9	13	6	12		0.0	0.0
Rochester	523	86	102	29.42	29.98	+.01	69.8	−0.9	92	21	79	48	14	60	26	61	55	62	2.39	−0.7	10	5,338	sw.	35	w.	12	14	7	10	4.8	0.0	0.0
Syracuse	597	97	113	29.35	29.99	+.02	69.0	−1.8	90	21	78	48	15	60	27				2.57	−1.1	9	4,797	s.	30	w.	9	11	13	7	5.4	0.0	0.0
Erie	714	130	166	29.22	29.97	−.01	70.5	−0.5	94	21	79	50	14	62	26	63	58	65	2.41	−0.8	7	8,544	w.	38	sw.	12	13	15	3	4.0	0.0	0.0
Cleveland	762	190	201	29.17	29.98	−.01	71.6	+0.2	98	20	79	51	14	64	26	63	57	62	2.86	−0.7	6	7,744	sw.	42	ne.	13	13	9	9	5.1	0.0	0.0
Sandusky	629	62	70	29.30	29.97	−.02	72.7	−0.7	99	21	80	55	14	65	27				2.61	−1.2	7	5,777	sw.	30	w.	10	9	13	9	5.2	0.0	0.0
Toledo	628	208	243	29.31	29.98	−.01	72.8	−0.4	97	21	81	53	11	64	25	64	59	65	0.83	−2.4	8	8,932	sw.	46	sw.	9	15	9	7	4.0	0.0	0.0
Fort Wayne	856	113	124	29.06	29.97		73.0	−0.5	96	21	83	51	14	63	32	64	59	65	2.65		10	6,089	sw.	33	w.	9	12	14	5	4.3	0.0	0.0
Detroit	730	218	258	29.21	29.98	.00	72.4	+0.3	97	21	82	52	11	63	27	62	56	61	1.24	−2.2	5	7,458	sw.	47	sw.	9	14	12	5	4.7	0.0	0.0
Upper Lake Region							67.6	−0.6										71	2.74	−0.4										4.9		
Alpena	609	13	92	29.32	29.98	+.01	64.8	−1.1	98	20	75	41	13	54	35	60	56	72	3.60	+0.5	8	6,861	nw.	40	nw.	12	16	10	5	4.2	0.0	0.0
Escanaba	612	54	60	29.30	29.95	−.02	65.6	−0.4	95	20	74	45	13	57	33	60	57	75	2.68	−0.7	15	5,737	s.	31	n.	11	9	14	8	5.1	0.0	0.0
Grand Haven	632	54	89	29.29	29.95	−.03	68.4	−0.3	85	8	77	48	15	60	28	62	57	67	1.06	−1.5	7	7,071	e.	29	s.	16	11	15	5	4.8	0.0	0.0
Grand Rapids	707	70	87	29.21	29.96	−.02	72.3	0.0	95	21	83	51	14	61	31	62	56	59	2.93	+0.3	7	4,072	e.	20	w.	17	9	13	9	5.6	0.0	0.0
Houghton	668	62	99	29.22	29.95	−.01	63.8	−1.7	85	7	74	45	9	54	30				3.31	+0.2	9	6,726	e.	33	w.	20	7	12	12	5.9	0.0	0.0
Lansing	878	11	62	29.04	29.96		70.8	−0.1	96	21	84	46	14	58	33	63	58	66	1.49	−1.7	5	3,392	ne.	20	nw.	10	9	15	7	4.8	0.0	0.0
Ludington	637	60	66	29.27	29.96		66.2		85	3	74	47	13	58	31	60	56	71	0.77		7	6,745	s.	34	s.	17	17	10	4	3.6	0.0	0.0
Marquette	734	77	111	29.17	29.96	.00	63.7	−1.2	92	20	73	47	2	55	34	58	54	74	4.46	+1.4	10	5,415	s.	41	nw.	16	9	7	15	6.2	0.0	0.0
Port Huron	638	70	120	29.29	29.97	−.01	69.2	+0.4	97	21	78	51	1	60	31	62	58	72	1.83	−0.9	3	6,744	ne.	58	sw.	9	19	8	4	3.4	0.0	0.0
Saginaw	641			29.28	29.97		70.6	−0.5	99	21	84	46	14	57	36				3.06		8		w.				14	8	9		0.0	0.0
Sault Sainte Marie	614	11	52	29.28	29.96	−.01	63.1	−0.7	84	20	74	44	13	52	30	57	54	76	4.58	+1.8	12	4,603	w.	34	nw.	12	12	13	6	4.3	0.0	0.0
Chicago	673	7	131	29.26	29.98	.00	71.1	−1.4	96	21	78	52	14	64	29	64	61	74	3.21	−0.4	12	7,518	ne.	36	sw.	20	12	11	8	4.6	0.0	0.0
Green Bay	617	109	141	29.29	29.95	−.02	69.6	−0.4	96	20	79	48	13	60	31	63	59	71	2.13	−1.4	9	6,725	s.	34	s.	20	8	14	9	5.5	0.0	0.0
Milwaukee	681	125	139	29.23	29.96	−.01	69.6	−0.5	96	21	77	54	12	62	34	62	58	68	2.43	−0.6	13	6,720	sw.	30	sw.	20	10	11	10	5.4	0.0	0.0
Duluth	1,133	5	47	28.76	29.96	+.01	63.6	−0.3	90	20	74	43	12	53	38	58	54	77	1.84	−1.8	11	7,484	ne.	36	nw.	16	11	12	8	4.7	0.0	0.0
North Dakota							70.5	+1.8										60	2.20	−0.7										4.0		
Moorhead	940	50	58	28.92	29.92	−.02	70.2	+2.1	94	18	82	41	12	58	36	62	57	65	2.92	−0.8	10	4,942	n.	29	sw.	20	10	12	9	5.2	0.0	0.0
Bismarck	1,674	8	57	28.21	29.95	+.02	72.2	+2.4	98	31	85	47	22	59	44	60	52	56	1.84	−0.3	8	6,587	se.	38	nw.	19	16	13	2	3.3	0.0	0.0
Devils Lake	1,478	11	44	28.39	29.93	.00	68.0	−0.1	100	31	82	38	12	54	41	59	54	65	1.65	−2.1	5	5,728	se.	27	ne.	8	15	9	7	4.2	0.0	0.0
Ellendale	1,457	10	56	28.40	29.94		70.4		103	18	84	46	12	57	43				2.39		12	8,389	se.	47	nw.	3	13	11	7	4.6	0.0	0.0
Grand Forks	833	12	67				67.8		95	31	80	39	12	55	40	62			1.83		9		nw.	48	nw.	22	18	12	1	3.5	0.0	0.0
Williston	1,878	41	48	27.97	29.90	−.02	71.6	+2.7	103	31	85	44	22	58	41	59	52	56	2.40	+0.4	12	5,456	se.	30	nw.	9	21	6	4	3.3	0.0	0.0
Upper Mississippi Valley							75.4	+0.4										66	3.59	−0.1										5.2		
Minneapolis	918	102	208	28.94	29.90		72.7	+0.4	102	16	82	50	13	63	34				3.49	−0.3	14	7,190	s.	29	n.	12	6	14	11	6.0	0.0	0.0
St. Paul	837	236	261	29.03	29.92	−.03	71.8	−0.3	99	20	81	49	13	62	30				2.92	−0.5	12	7,329	se.	32	s.	8	7	17	7	5.5	0.0	0.0
La Crosse	714	11	48	29.17	29.92	−.04	72.2	−0.6	98	20	83	48	13	62	31				5.19	+1.1	10	3,096	se.	16	s.	20	8	12	11	6.0	0.0	0.0
Madison	974	70	78	28.93	29.95	−.02	71.0	−1.1	94	20	80	53	14	62	27	63	59	68	3.26	−0.7	15	5,656	sw.	25	sw.	16	9	10	12	5.6	0.0	0.0
Wausau	1,247	4		28.65	29.96		68.0		91	20	79	44	13	57	31				4.38		14		s.				11	7	13	5.8	0.0	0.0
Charles City	1,015	10	49	28.88	29.92	−.04	72.8	+0.5	102	20	83	46	14	62	35	64	60	68	6.07	+2.5	12	4,742	se.	23	sw.	19	13	11	7	4.4	0.0	0.0
Davenport	606	71	79	29.29	29.94	−.04	75.7	+0.4	96	20	86	53	14	66	28	66	62	66	2.98	−0.6	10	5,195	e.	23	e.	26	8	14	9	5.7	0.0	0.0
Des Moines	861	84	97	29.03	29.91	−.05	76.2	+0.8	98	20	86	54	13	66	29	67	63	69	3.69	−0.2	10	5,974	sw.	32	sw.	20	7	8	16	6.3	0.0	0.0
Dubuque	700	81	96	29.18	29.92	−.05	73.2	−0.9	97	20	82	51	14	64	26	65	60	67	5.89	+1.6	14	4,258	s.	21	nw.	21	7	13	11	6.0	0.0	0.0
Keokuk	614	64	78	29.28	29.95	−.03	77.4	+0.5	96	2	87	53	14	67	26	68	63	65	2.77	−1.3	9	4,902	sw.	27	sw.	9	10	11	10	5.2	0.0	0.0
Cairo	358	87	93	29.57	29.94	−.06	80.0	+0.4	101	3	90	61	15	70	27	70	65	67	3.22	−0.2	11	4,668	s.	42	ne.	6	9	14	8	5.2	0.0	0.0
Peoria	609	11	45	29.31	29.97	−.01	75.8	+0.4	96	21	86	50	14	65	28	67	63	69	5.94	+3.0	9	3,881	ne.	24	sw.	9	17	11	3	3.8	0.0	0.0
Springfield, Ill	636	10	91	29.28	29.94	−.04	77.8	+1.3	97	21	89	54	13	67	31	67	63	66	2.40	−0.5	7	5,029	sw.	33	nw.	6	13	10	8	4.6	0.0	0.0
Hannibal	534	74	109	29.38	29.94	−.04	77.8	+1.0	99	2	88	51	14	68	28				1.90	−1.8	8	5,247	sw.	30	sw.	9	11	15	5	4.3	0.0	0.0
St. Louis	568	265	303	29.35	29.94	−.05	81.0	+2.4	98	2	90	60	14	72	23	68	62	58	0.54	−2.9	4	7,213	sw.	44	nw.	9	17	7	7	4.1	0.0	0.0
Missouri Valley							77.0	+1.1										62	2.91	−1.0										4.2		
Columbia, Mo	784	11	84	29.13	29.94	−.04	77.2	+0.3	97	2	88	51	14	66	29				4.15	+0.5	8	4,290	s.	38	nw.	6	14	10	7	4.3	0.0	0.0
Kansas City	963	161	181	28.92	29.92	−.05	78.9	+0.8	99	2	89	61	14	69	25	68	63	63	6.59	+1.8	10	7,117	s.	41	nw.	8	15	12	4	3.9	0.0	0.0
St. Joseph	967	11	49	28.91	29.91		78.6		101	2	89	59	11	68	28	68	64	66	3.78		9	5,392	sw.	34	nw.	21	17	13	1	2.8	0.0	0.0
Springfield, Mo	1,324	98	104	28.60	29.97	−.01	77.4	+0.6	96	5	87	56	14	67	27	67	62	64	1.02	−3.8	6	5,353	s.	35	se.	7	21	9	1	2.3	0.0	0.0
Iola	984	11	50	28.92	29.94	−.03	78.0	−0.2	101	5	90	53	14	66	32				2.73	−1.7	6	3,879	s.	34	se.	7	17	7	7	3.9	0.0	0.0
Topeka	987	92	107				79.0	+1.2	102	2	90	59	14	68	30				2.42	−2.4	9	6,908	sw.	33	n.	21	16	14	1	3.2	0.0	0.0
Lincoln	1,189	11	84	28.67	29.90	−.05	78.6	+2.1	103	20	90	55	13	68	34	67	61	61	1.84	−2.0	10	7,524	s.	34	n.	14	6	13	12	6.1	0.0	0.0
Omaha	1,105	115	122	28.76	29.90	−.05	78.2	+1.5	102	19	88	55	13	68	28	67	61	61	3.13	−1.2	9	3,729	n.	33	nw.	23	12	14	5	4.2	0.0	0.0
Valentine	2,598	47	54	27.27	29.93	.00	74.1	+0.4	106	19	87	48	22	61	40	62	56	59	2.34	−1.1	9	6,383	n.	52	sw.	19	12	13	6	4.5	0.0	0.0
Sioux City	1,135	94	164	28.73	29.90	−.05	76.5	+2.2	104	19	87	50	13	66	39	66	60	62	1.99	−1.6	10	7,993	s.	42	s.	23	6	16	9	5.4	0.0	0.0
Huron	1,306	59	74	28.57	29.93	−.01	74.0	+2.2	103	18	86	52	13	62	40	63	57	61	3.22	+0.3	10	6,023	se.	46	nw.	20	10	18	3	4.4	0.0	0.0
Pierre	1,572	70	75		29.91	−.02	75.1	−0.2	107	18	87	54	13	63	41			58	3.93	+1.6	12	6,121	e.	42	ne.	20	13	14	4		0.0	0.0
Yankton	1,233	49	57	28.61	29.89	−.05	76.6	+2.4	108	19	88	47	13	65	36				1.60	−1.9	8	4,884	n.	36	se.	23	6	17	8	5.6	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, July, 1926*—Continued

District and station	Elevation of instruments			Pressure			Temperature of the air									Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation			Wind					Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Barometer above sea level	Thermometer above ground	Anemometer above ground	Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range				Total	Departure from normal	Days with 0.01, or more	Total movement	Prevailing direction	Maximum velocity: Miles per hour	Maximum velocity: Direction	Maximum velocity: Date						
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0–10	In.	In.
Northern Slope							70.1	+2.3										54	1.53	−0.1										4.2		
Billings	3,140	5					72.2		103	31	91	41	21	54	51				0.37		5		nw.				17	7	7		0.0	0.0
Havre	2,505	11	44	27.32	29.89	−.02	73.0	+4.7	102	30	89	44	21	57	48	57	46	47	0.66	−1.3	3	4,007	e.	30	sw.	26	24	6	1	2.4	0.0	0.0
Helena	4,110	87	112	25.82	29.93	.00	69.5	+3.8	94	30	84	44	21	55	38	54	43	46	1.61	+0.5	5	5,783	sw.	29	sw.	22	12	14	5	4.3	0.0	0.0
Kalispell	2,973	48	56	26.90	29.88	−.05	68.6	+4.5	94	30	84	43	21	53	42	53	41	45	0.20	−0.6	1	4,486	nw.	26	sw.	12	22	8	1	2.5	0.0	0.0
Miles City	2,371	48	55	27.45	29.93	+.01	76.6	+3.7	104	31	90	50	21	63	36	61	51	48	0.41	−1.0	7	4,654	se.	29	ne.	22	20	7	4	3.0	0.0	0.0
Rapid City	3,259	50	58	26.63	29.96	+.03	71.2	+0.2	96	18	82	51	10	60	34	61	54	59	3.09	+0.5	11	4,962	se.	30	nw.	9	8	16	7	5.3	0.0	0.0
Cheyenne	6,088	84	101	24.12	29.96	+.04	65.2	−1.5	92	17	78	43	30	53	38	54	48	62	2.91	+0.9	18	7,038	w.	50	sw.	19	7	14	10	5.8	0.0	0.0
Lander	5,372	60	68	24.73	29.95	+.03	68.3	+0.9	94	16	82	47	29	55	41	55	47	55	2.06	+1.2	8	3,594	sw.	40	sw.	1	12	12	7	4.8	0.0	0.0
Sheridan	3,790	10	47	26.12	29.95		69.8		102	17	86	45	22	54	52	58	51	59	0.97		6	3,214	nw.	30	nw.	19	11	15	5	4.7	0.0	0.0
Yellowstone Park	6,241	11	48	23.99	29.97	+.05	62.9	+1.4	86	31	78	38	21	48	39	50	41	54	0.18	−1.0	7	5,480	s.	34	s.	22	8	20	3	4.8	0.0	0.0
North Platte	2,821	11	51	27.08	29.94	+.01	75.8	+2.9	105	19	88	54	22	63	37	64	59	64	2.68	0.0	12	4,451	se.	35	nw.	11	16	9	6	3.9	0.0	0.0
Middle Slope							76.6	−0.5										59	3.30	+0.3										4.3		
Denver	5,292	106	113	24.82	29.98	+.07	70.8	−1.4	97	19	82	53	22	59	34	56	48	55	1.00	−0.6	7	4,896	s.	33	nw.	12	9	17	5	5.2	0.0	0.0
Pueblo	4,685	80	86	25.34	29.93	+.02	73.8	−0.4	101	19	88	54	26	60	39	57	49	51	2.31	+0.3	14	4,394	nw.	30	n.	20	6	22	3	4.9	0.0	0.0
Concordia	1,392	50	58	28.47	29.90	−.05	79.5	+1.5	103	1	91	59	11	68	31	66	60	59	2.56	−1.1	9	6,080	s.	33	n.	21	13	11	7	4.6	0.0	0.0
Dodge City	2,509	11	51	27.41	29.94	+.01	77.8	−0.6	98	2	91	60	13	65	32	65	59	61	3.76	+0.4	9	6,492	se.	30	se.	6	20	10	1	2.7	0.0	0.0
Wichita	1,358	139	158	28.53	29.92	−.04	78.8	−0.6	100	2	90	60	14	68	29	67	61	60	3.47	−0.2	9	8,938	s.	53	w.	8	17	11	3	3.5	0.0	0.0
Broken Arrow	765	11	56	29.15	29.96		78.6		98	5	89	56	14	68	27				1.84		8	6,793	s.	52	nw.	9	10	15	6	5.0	0.0	0.0
Oklahoma City	1,214	10	47	28.69	29.93	−.03	79.1	−1.5	100	5	90	58	14	69	34	69	66	70	6.69	+3.0	12	6,200	s.	34	ne.	9	12	17	2	4.1	0.0	0.0
Southern Slope							78.7	−2.5										60	2.43	−0.1										3.8		
Abilene	1,738	10	52	28.18	29.91	−.02	80.4	−2.4	97	9	91	59	15	70	30	69	64	64	2.66	+0.3	8	6,174	s.	34	sw.	7	15	6	10	4.6	0.0	0.0
Amarillo	3,676	10	49	26.31	29.95	+.03	75.2	−1.6	94	16	88	58	10	63	34	64	57	62	2.27	−0.9	6	6,534	se.	29	n.	12	18	9	4	3.6	0.0	0.0
Del Rio	944	64	71	28.93	29.90	.00	82.8	−3.5	98	29	92	68	2	74	23				3.34	+1.1	7	7,022	se.	42	se.	3	12	14	5	4.6	0.0	0.0
Roswell	3,566	75	85	26.36	29.89	+.01	76.4	−2.5	98	8	89	59	20	64	38	62	54	54	1.44	−0.7	5	5,241	se.	31	se.	19	22	7	2	2.4	0.0	0.0
Southern Plateau							78.6	−0.4										47	1.18	−0.1										2.8		
El Paso	3,778	152	175	26.16	29.84	.00	81.5	+0.4	99	1	93	63	27	70	30	62	51	42	3.31	+1.2	9	7,327	e.	39	ne.	13	19	12	0	3.0	0.0	0.0
Santa Fe	7,013	38	53	23.36	29.88	.00	67.2	−1.8	88	18	79	48	12	55	31	55	49	60	1.13	−1.6	12	4,405	se.	34	nw.	12	13	15	3	4.3	0.0	0.0
Flagstaff	6,907	10	59	23.45	29.87	+.04	64.0	−1.0	88	19	80	34	9	48	43	50		57	1.98		11	5,001	nw.	30	w.	2	8	22	1		0.0	0.0
Phoenix	1,108	10	82	28.65	29.76	−.02	89.6	−0.2	111	19	103	66	9	76	35	67	54	36	1.31	+0.2	3	4,071	e.	37	ne.	31	17	12	2	3.0	0.0	0.0
Yuma	141	9	54	29.60	29.74	−.02	91.4	+0.6	113	19	107	61	9	76	38	71	60	41	0.14	0.0	1	4,103	sw.	36	ne.	31	29	2	0	0.9	0.0	0.0
Independence	3,957	5	25	25.90	29.83	.00	77.9	−0.2	104	15	96	52	28	60	42	54			0.01	−0.1	1		nw.				20	6	5	2.6	0.0	0.0
Middle Plateau							73.9	+1.5										35	0.57	0.0										3.3		
Reno	4,532	74	81	25.46	29.86	−.01	72.9	+5.4	99	15	90	47	28	55	44	52	36	33	T.	−0.3	0	5,509	w.	36	w.	21	23	7	1	2.0	0.0	0.0
Tonopah	6,090	12	20				73.9		94	16	85	48	8	62	29	52	34	29	0.38		4		se.								0.0	0.0
Winnemucca	4,344	18	56	25.59	29.88	−.02	73.0	+2.4	99	15	92	46	23	54	50	53	38	36	0.14	0.0	3	4,363	sw.	40	nw.	13	22	9	0	2.7	0.0	0.0
Modena	5,473	10	43	24.65	29.86	.00	70.6	0.0	96	16	87	44	11	54	43	52	37	37	0.52	−0.7	7	7,729	w.	39	s.	26	17	9	5	3.7	0.0	0.0
Salt Lake City	4,360	163	203	25.61	29.89	−.01	76.6	+0.9	101	16	89	53	9	64	34	56	43	36	1.21	+0.7	7	5,691	s.	46	se.	19	14	11	6	4.1	0.0	0.0
Grand Junction	4,602	60	68	25.40	29.91	+.02	76.6	−1.1	98	19	90	56	12	63	35	57	45	41	0.99	+0.5	12	4,956	se.	38	sw.	1	14	13	4	4.2	0.0	0.0
Northern Plateau							75.4	+4.3										36	0.30	−0.2										2.5		
Baker	3,471	48	53		29.98	+.03	69.5	+3.9	94	12	86	40	28	54	46			40	0.80	+0.4	4	4,226	nw.	25	sw.	3	21	8	2		0.0	0.0
Boise	2,739	78	86	27.00	29.88	−.05	76.8	+3.9	99	12	92	50	20	62	42	57	42	35	0.21	0.0	4	3,230	nw.	30	w.	6	23	6	2	2.3	0.0	0.0
Lewiston	757	40	48	29.10	29.89	−.06	78.7	+4.7	108	11	95	53	28	62	42				T.	−0.4	0	2,739	e.	25	nw.	18	23	7	1	2.1	0.0	0.0
Pocatello	4,477	60	68	25.47	29.87	−.05	74.4	+3.6	99	16	89	47	21	60	41	55	40	38	0.76	+0.1	7	5,965	se.	50	s.	26	10	16	5	4.7	0.0	0.0
Spokane	1,929	101	110	27.91	29.90	−.06	74.3	+5.3	103	11	89	50	28	60	39	55	40	34	0.02	−0.6	1	4,526	s.	25	nw.	12	23	8	0	2.0	0.0	0.0
Walla Walla	991	57	65	28.85	29.90	−.07	78.4	+4.4	107	11	92	53	21	65	39	58	43	32	0.01	−0.4	1	3,594	s.	19	nw.	6	25	6	0	1.4	0.0	0.0
North Pacific Coast Region							64.7	+2.6										69	0.18	−0.5										4.0		
North Head	211	11	56	29.86	30.08	.00	58.0	+0.8	67	29	62	51	9	54	11	56	54	88	0.22	−0.3	6	10,779	n.	40	n.	21	8	8	15	6.3	0.0	0.0
Port Angeles	29	8	53		30.04		59.9		82	10	69	45	21	51	33				T.	−0.4	0	6,124	sw.	29	sw.	12	12	9	10		0.0	0.0
Seattle	125	215	250	29.90	30.03	−.01	66.0	+2.9	93	10	76	50	8	56	32	56	50	62	0.01	−0.6	1	5,605	ne.	24	s.	22	16	8	7	4.0	0.0	0.0
Tacoma	194	172	201	29.84	30.04	−.02	66.2	+3.4	93	10	76	50	28	56	33				0.01	−0.6	1	5,748	n.	30	sw.	22	13	13	5	4.5	0.0	0.0
Tatoosh Island	86	9	53	29.97	30.06	+.01	56.9	+1.8	64	20	60	51	16	54	11	55	53	89	1.02	−0.8	14	6,487	s.	28	s.	12	6	12	13	6.3	0.0	0.0
Yakima	1,071	5					74.8		108	11	93	43	19	56	46				T.		0		nw.				21	10	0	2.7	0.0	0.0
Medford	1,425	4					73.6		106	10	93	42	8	54	50	60	53	62	0.22		1		nw.				21	9	1		0.0	0.0
Portland, Oreg.	153	68	106	29.86	30.02	−.03	70.5	+3.8	104	10	83	51	8	58	36	60	53	60	0.00	−0.6	0	4,396	nw.	20	nw.	6	22	7	2	2.5	0.0	0.0
Roseburg	510	9	57	29.47	30.01	−.02	70.4	+3.0	107	10	88	44	8	53	47	57	48	53	0.00	−0.3	0	2,965	n.	16	nw.	12	23	7	1	1.8	0.0	0.0
Middle Pacific Coast Region							67.0	+2.2										62	T.	0.0										2.4		
Eureka	62	73	89	29.98	30.05	.00	56.9	+1.4	66	23	61	46	8	52	14	54	52	86	0.01	−0.1	1	4,839	nw.	25	n.	30	14	9	8	4.5	0.0	0.0
Point Reyes	490	7	18	29.34	29.86		53.9	+0.2	62	15	58	48	3	50	11				0.00		0	21,311	n.	60	nw.	23	11	8	12	5.3	0.0	0.0
Red Bluff	332	50	56	29.47	29.81	−.08	84.2	+3.4	109	15	100	58	28	68	39	63	49	34	0.00	0.0	0	3,601	se.	22	n.	8	28	3	0	0.7	0.0	0.0
Sacramento	69	106	117	29.76	29.83	−.05	77.0	+3.8	109	15	94	54	1	60	45	61	50	48	0.00	0.0	0	5,954	s.	23	s.	21	30	1	0	0.5	0.0	0.0
San Francisco	155	208	243	29.74	29.91	−.04	61.1	+2.6	86	15	69	51	2	54	29	55	52	80	0.00	0.0	0	7,177	sw.	34	sw.	19	19	12	0	2.8	0.0	0.0
San Jose	141	12	110	29.76	29.91		68.8	+1.9	99	15	84	48	20	53	47				0.00	0.0	0	4,761	nw.	21	nw.	7	30	1	0	0.7	0.0	0.0
South Pacific Coast Region							71.4	+0.3										64	T.	0.0										2.5		
Fresno	327	89	98	29.47	29.82	−.01	83.6	+1.5	110	16	100	57	1	67	38	60	40	28	0.00	0.0	0	5,986	nw.	22	nw.	21	30	1	0	0.5	0.0	0.0
Los Angeles	338	159	191	29.53	29.88	−.02	69.8	−0.4	89	19	79	56	6	60	28	62	59	77	T.	0.0	0	3,625	sw.	14	sw.	6	18	11	2	3.5	0.0	0.0
San Diego	87	62	70	29.80	29.89	−.03	67.6	+0.4	80	19	72	60	13	63	16	63	61	82	T.	0.0	0	4,802	w.	18	w.	5	19	8	4	4.1	0.0	0.0
San Luis Obispo	201	32	40	29.71	29.93	−.02	64.4	−0.3	92	19	78	49	25	51	38	55	50	70	0.00	0.0	0	2,724	sw.	14	nw.	26	28	3	0	1.9	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.90	29.98		80.4	+0.3	90	29	85	72	17	76	15				6.89	+0.5	14	9,383	e.	66	e.	23	8	15	8	5.4	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.71	29.83	.00	80.2	−0.1	91	19	86	71	18	74	18	76	75	88	9.93	+2.6	23	4,073	nw.	24	nw.	19	0	7	24	8.3	0.0	0.0
Colon	38	7	97	29.81	29.84	−.01	81.2	+0.8	90	13	87	73	18	76	15	77	76	88	16.15	+3.8	27	3,689	w.	21	w.	23	0	5	26	8.7	0.0	0.0
Alaska																																
Juneau	80	11	54				57.6		77	12	64	46	28	51	30	54	50	80	4.00		21	4,008	s.	41	se.	12	3	7	21	7.7	0.0	0.0
Hawaiian Islands																																
Honolulu	38	86	100				79.0		86	28	84	70	6	74	14	70	66	67	0.36	−0.8	13	7,389	e.	28	e	20	12	18	1	4.4	0.0	0.0

TABLE 2.—*Data furnished by the Canadian Meteorological Service, July, 1926*

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure: Station reduced to mean of 24 hours	Pressure: Sea level reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Mean maximum	Temperature of the air: Mean minimum	Temperature of the air: Highest	Temperature of the air: Lowest	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Total snowfall
	Feet	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F.*	°*F*	°*F.*	°*F.*	*In.*	*In.*	*In.*
St. Johns, N. F	125	29.67	29.80	−0.17	58.4	−0.9	67.8	49.0	81	40	2.79	−1.10	0.0
Sydney, C. B. I	48												
Halifax, N. S	88												
Yarmouth, N. S	65												
Charlottetown, P. E. I	38												
Chatham, N. B	28												
Father Point, Que	20	29.84	29.86	+.01	57.0	−0.6	65.2	48.8	85	44	1.88	−1.16	0.0
Quebec, Que	296	29.61	29.93	+.02	65.6	+0.1	75.7	55.6	84	47	3.70	−0.56	0.0
Montreal, Que	187	29.71	29.91	−.02	69.2	+0.7	78.4	59.9	87	51	2.74	−1.55	0.0
Stonecliffe, Ont	489												
Ottawa, Ont	236	29.67	29.93	−.01	67.4	−2.1	78.2	56.7	88	46	4.26	+0.79	0.0
Kingston, Ont	285	29.65	29.95	−.02	66.7	−1.5	74.4	59.1	83	52	4.18	+1.29	0.0
Totonto, Ont	379	29.56	29.95	−.02	67.8	−0.2	77.8	57.8	91	46	1.77	−1.15	0.0
Cochrane, Ont	930				61.9		74.8	49.0	90	38	3.18		0.0
White River, Ont	1,244	28.60	29.90	−.04	59.3	−0.2	72.9	45.7	86	35	6.12	+3.32	0.0
Port Stanley, Ont	592												
Southampton, Ont	656	29.26			63.2	−1.5	74.8	51.6	90	41	2.43	+0.45	0.0
Parry Sound, Ont	688	29.27	29.95	−.01	65.0	−1.0	76.4	53.6	85	45	2.95	+0.33	0.0
Port Arthur, Ont	644	29.25	29.96	+.02	61.6	−0.4	70.8	52.4	81	44	5.54	+2.06	0.0
Winnipeg, Man	760												
Minnedosa, Man	1,690	28.16	29.94	+.01	65.5	+3.3	78.6	52.5	97	37	2.04	−0.56	0.0
Le Pas, Man	860				63.6		76.8	50.4	92	32	0.86		0.0
Qu'Appelle, Sask	2,115	27.69	29.90	−.02	65.6	+2.1	79.8	51.5	97	40	1.70	−0.78	0.0
Medicine Hat, Alb	2,144												
Moose Jaw, Sask	1,759				68.9		84.9	52.9	100	37	1.25		0.0
Swift Current, Sask	2,392	27.38	29.83	−.08	69.3	+2.8	85.9	52.8	98	38	2.49	+0.05	0.0
Calgary, Alb	3,428												
Banff, Alb	4,521												
Edmonton, Alb	2,150	27.63	29.86	−.04	64.6	+4.0	79.3	49.9	91	38	2.21	−0.82	0.0
Prince Albert, Sask	1,450	28.38	29.93	+.02	65.9	+4.0	78.2	53.7	95	44	2.69	+0.64	0.0
Battleford, Sask	1,592	28.20	29.91	+.01	65.2	+0.5	79.1	51.3	98	44	0.65	−1.69	0.0
Kamloops, B. C	1,262												
Victoria, B. C	230	29.78	30.03	−.02	61.5	+1.5	70.0	53.0	85	50	T.	−0.40	0.0
Barkerville, B. C	4,180												
Triangle Island, B. C	680												
Prince Rupert, B. C	170												
Hamilton, Ber	151	30.04	30.20	+.06	80.2	+1.5	87.5	72.9	91	71	2.64	+1.80	0.0

LATE REPORTS, JUNE, 1926

Stations	Altitude above mean sea level, Jan. 1, 1919	Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
St. Johns, N. F	125	29.66	29.80	−.11	54.4	+2.8	63.9	44.9	74	38	4.54	+0.94	0.0
Charlottetown, P. E. I	38	29.80	29.84	−.08	58.6	+1.2	66.6	50.6	79	43	1.92	−0.75	0.0
Cochrane, Ont	930				57.9		67.3	48.6	81	33	2.58		0.0
Southampton, Ont	656	29.16			54.0	−6.4	64.1	43.8	76	32	4.80	+2.45	0.0
Swift Current, Sask	2,392	27.41	29.90	+.03	58.4	−1.6	71.8	45.0	90	32	2.33	−0.34	0.0
Calgary, Alb	3,428	26.46	30.00	+.16	55.8	−0.2	76.3	42.4	95	31	4.55	+2.10	0.0
Kamloops, B. C	1,262	28.69	29.95	+.08	66.5	+2.7	79.7	53.4	97	38	0.97	−0.45	0.0
Barkerville, B. C	4,180	25.71	30.01	+.14	48.8	−1.9	59.3	38.4	80	28	4.07	+0.59	7.6

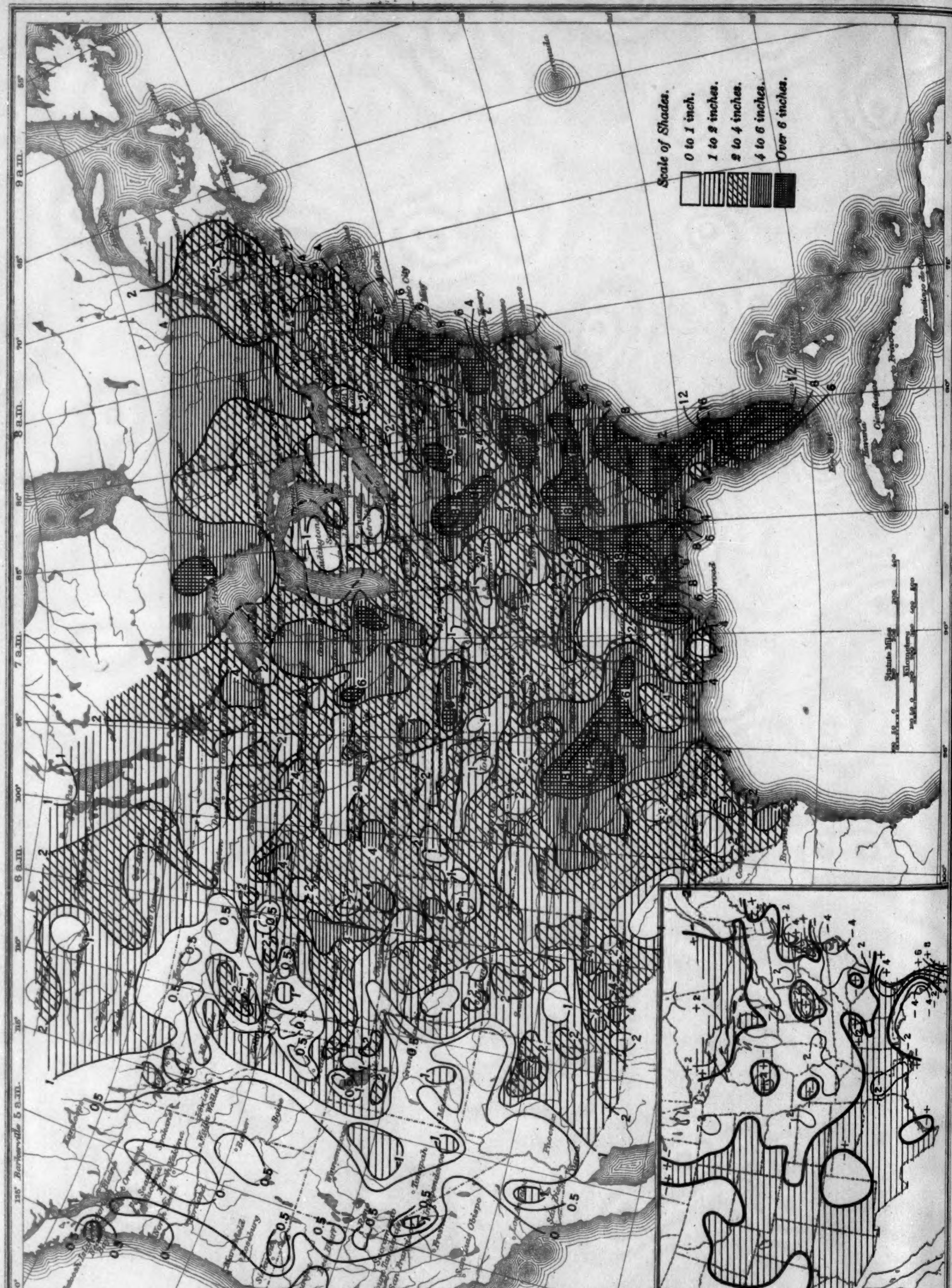

(Plotted by Wilfred P. Day)

Chart II. Tracks of Centers of Cyclones, July, 1926. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by Wilfred P. Day)

Departure (°F.) of the Mean Temperature from the Normal, July, 1926

Chart IV. Total Precipitation, Inches, July, 1926. (Inset) Departure of Precipitation from Normal



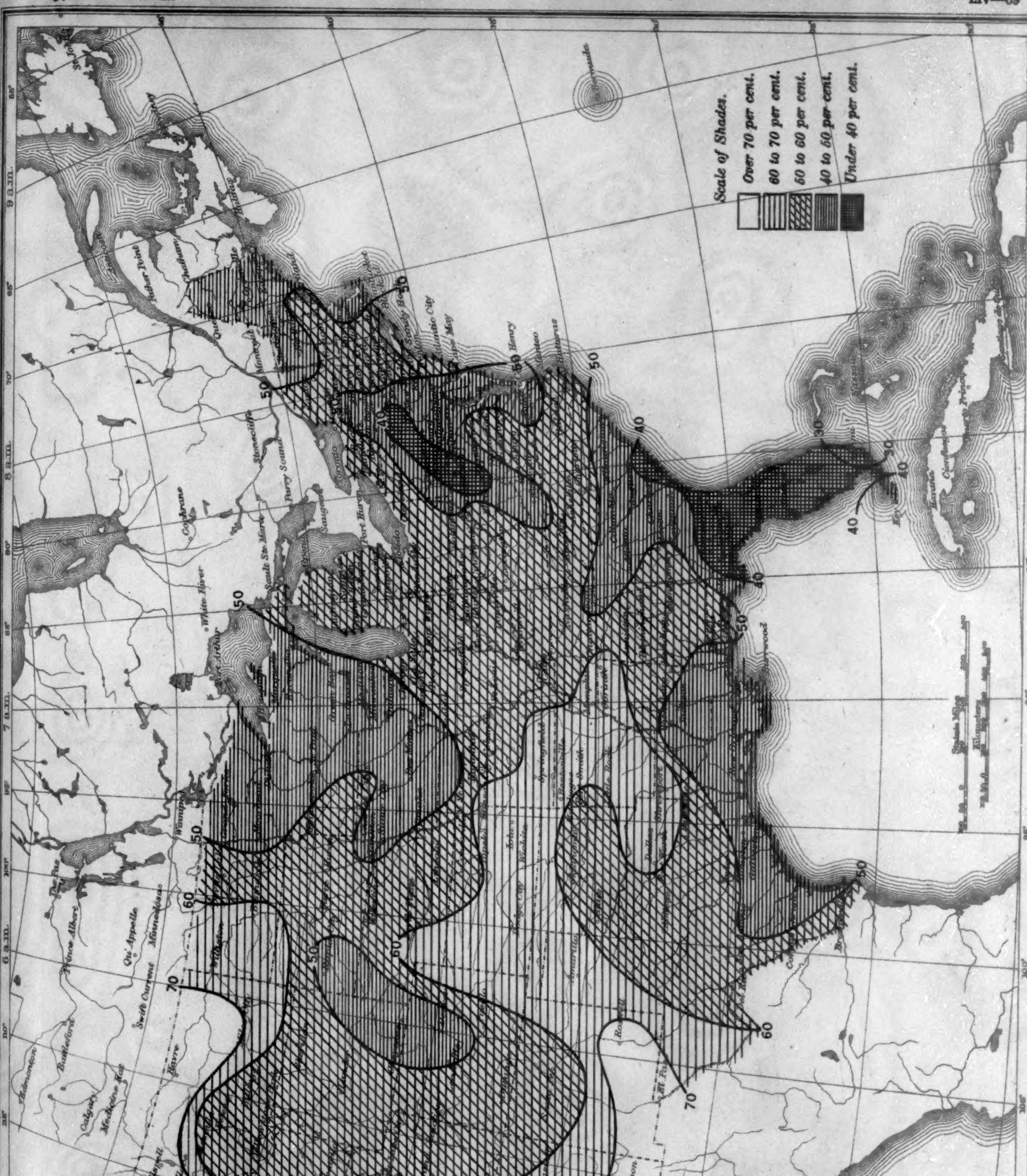
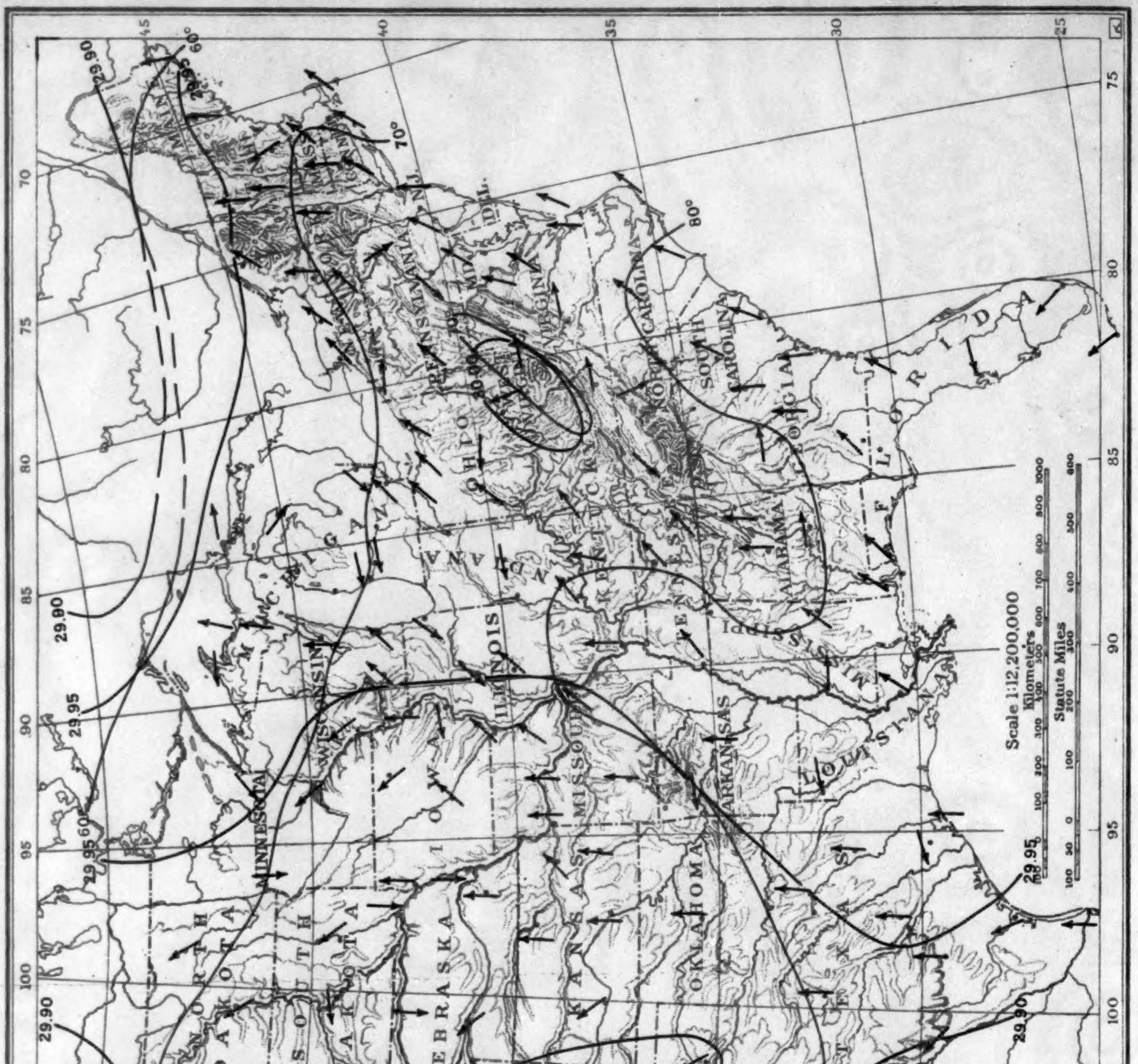
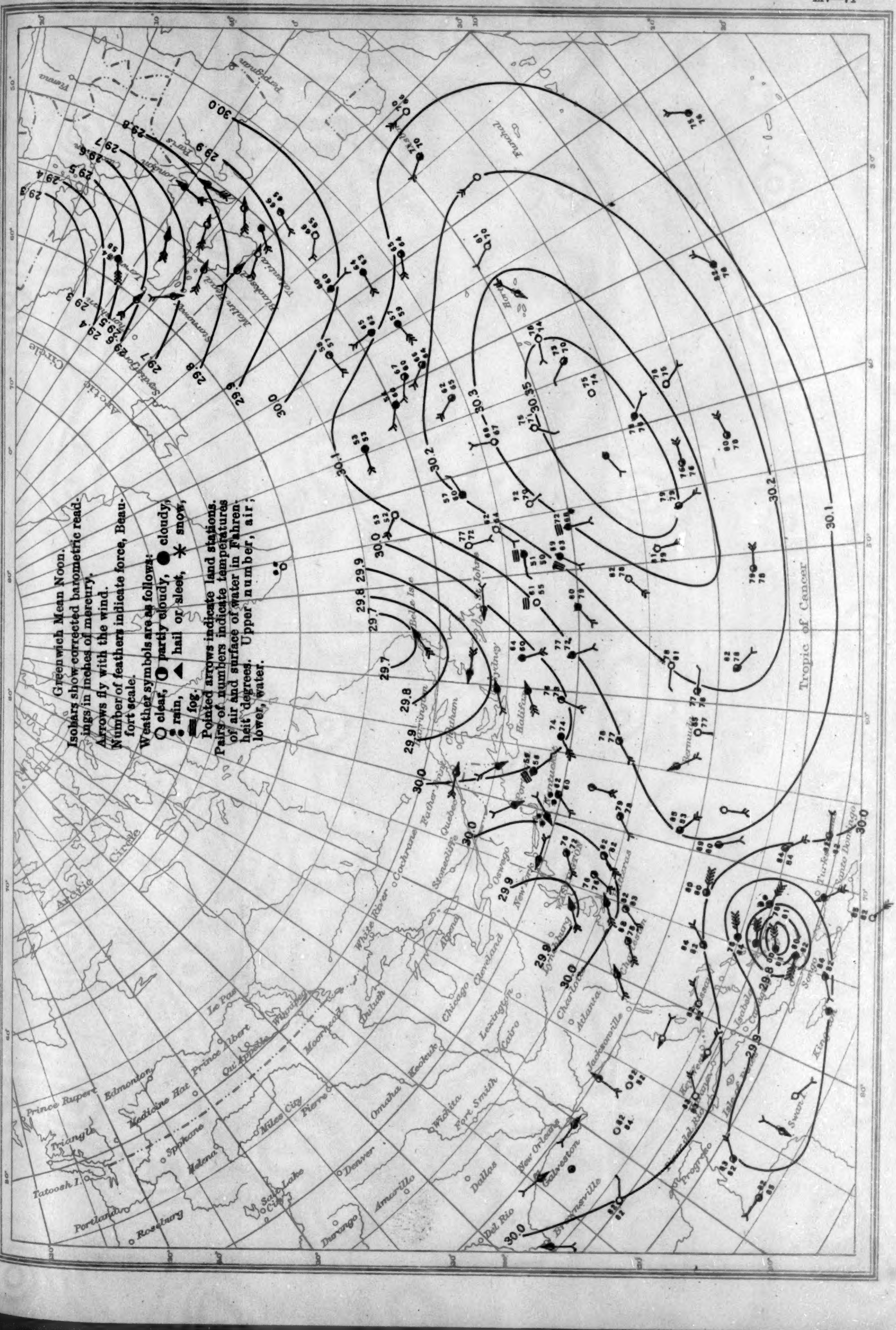


Chart V. Percentage of Clear Sky between Sunrise and Sunset, July, 1926

Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, July, 1926

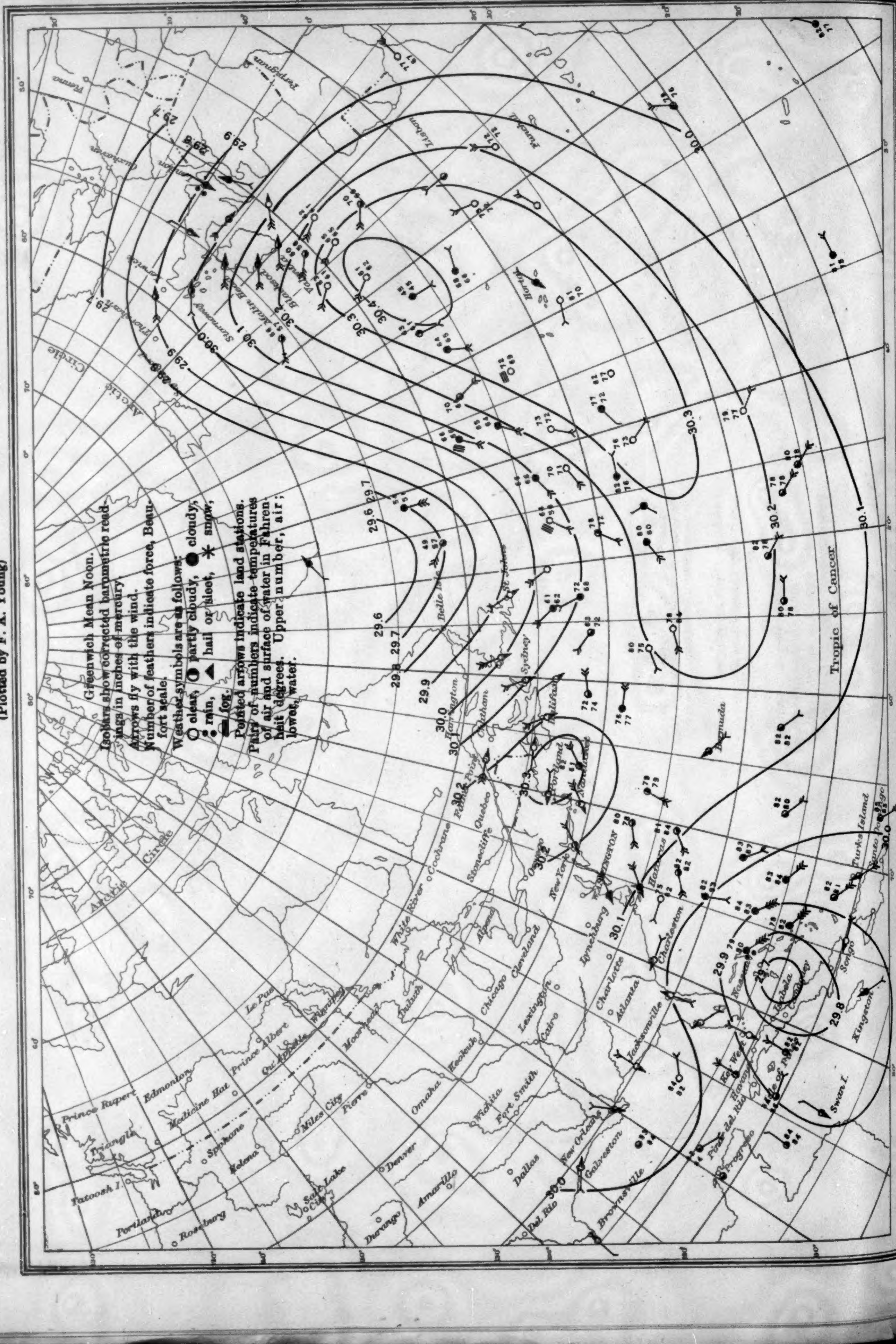




(Plotted by F. A. Young)

Chart IX. Weather Map of North Atlantic Ocean, July 26, 1926

(Plotted by F. A. Young)



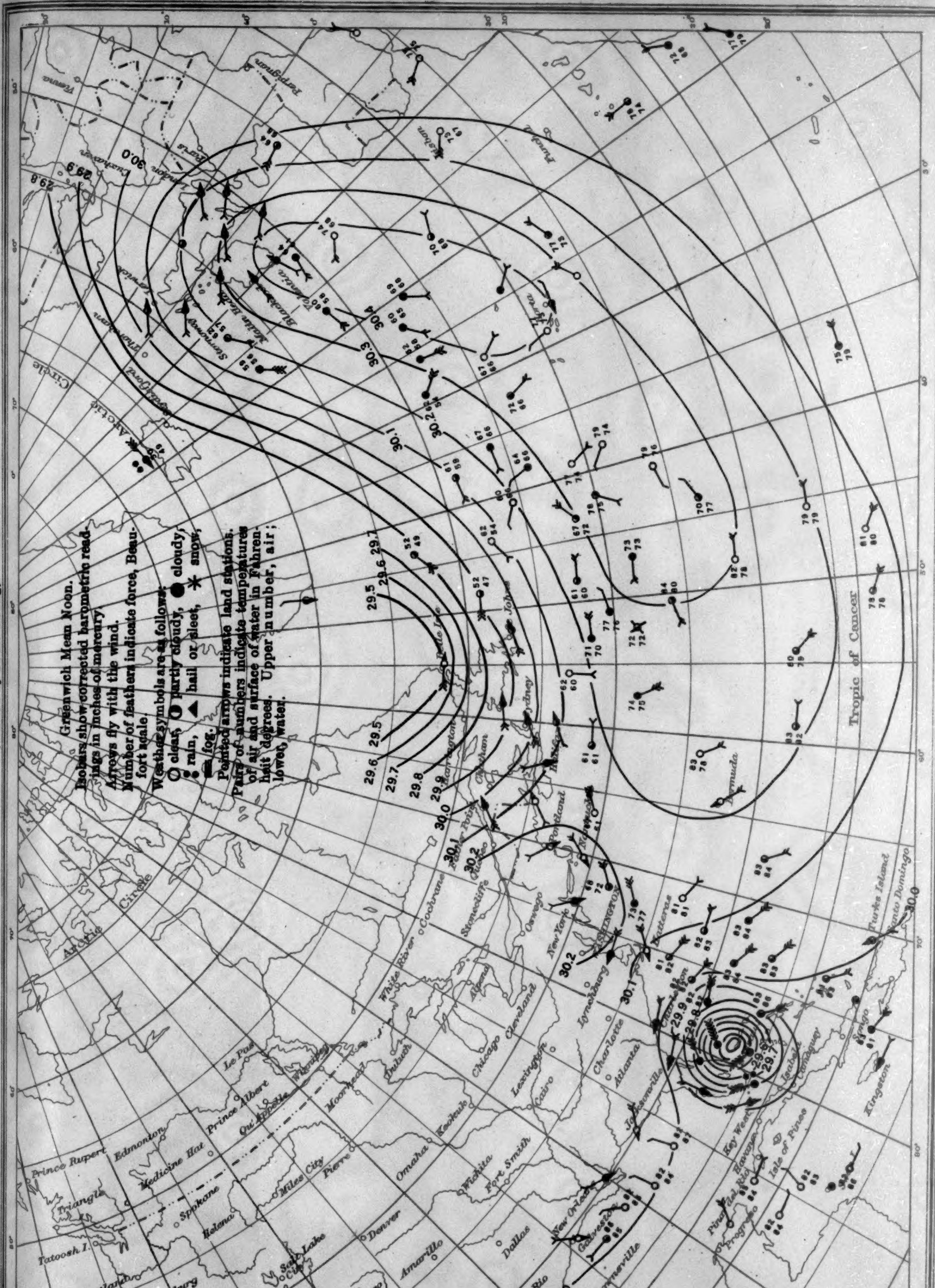
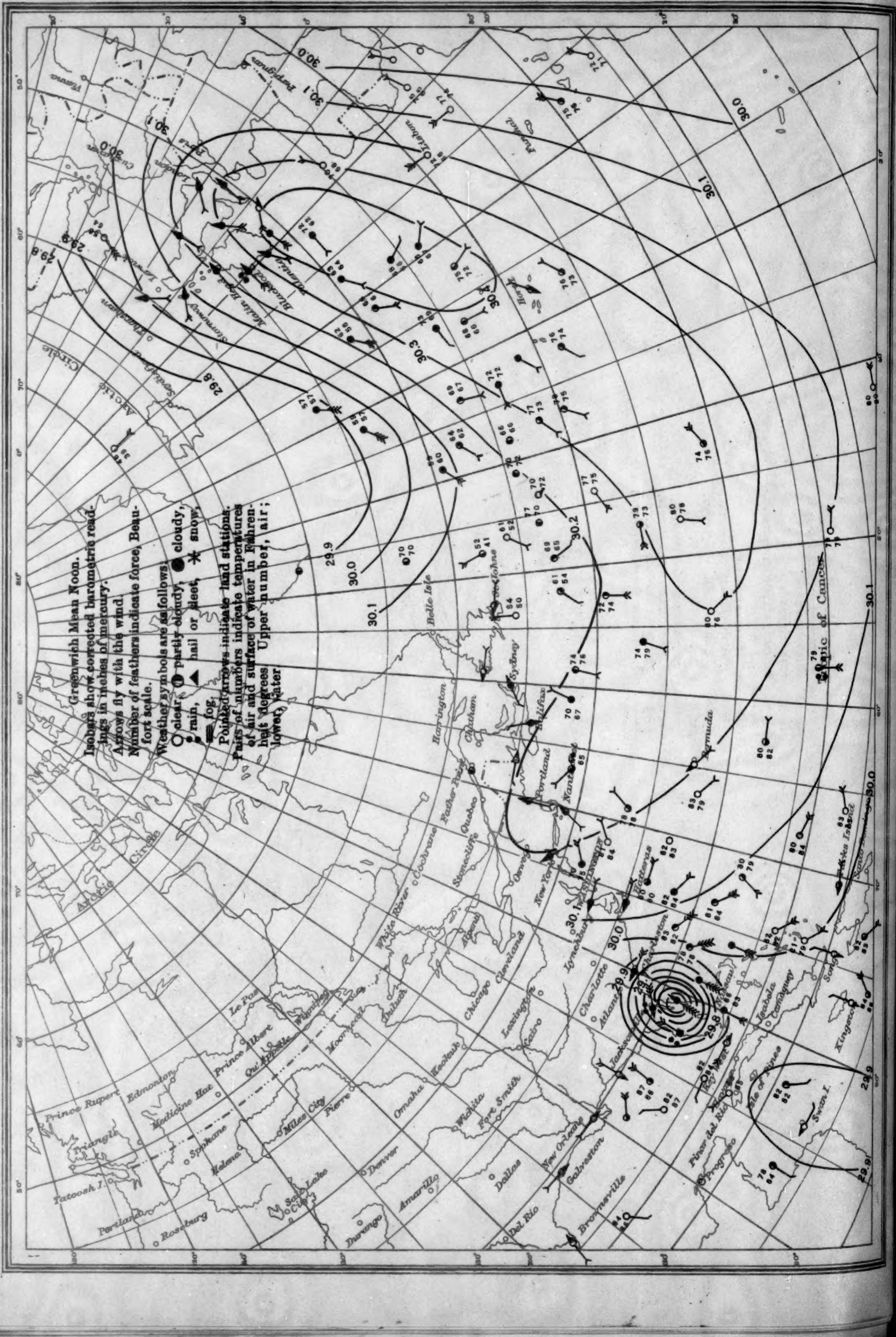

(Plotted by F. A. Young)
Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows: clear, partly cloudy, cloudy, rain, hail or sleet, snow, fog.
Painted arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Tropic of Cancer
Arctic Circle

Chart XI. Weather Map of North Atlantic Ocean, July 28, 1926
(Plotted by F. A. Young)



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